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January 16, 1930

Engineering News-Record

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High Rockfill Dam with Jointed Concrete Face

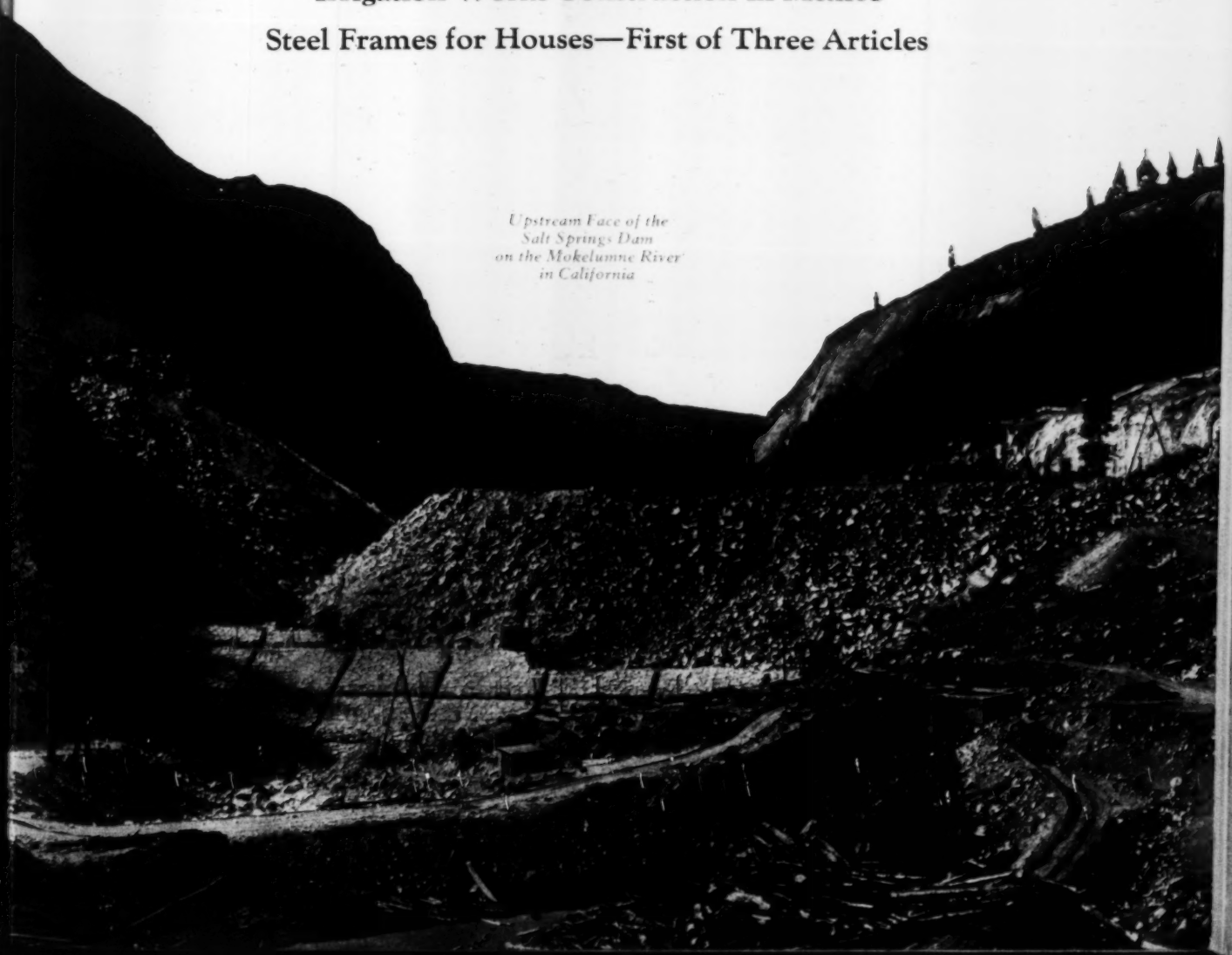
Efficient Concrete Plants for Two Buildings

Acoustic Correction of Auditoriums

Garbage and Refuse Disposal in Europe

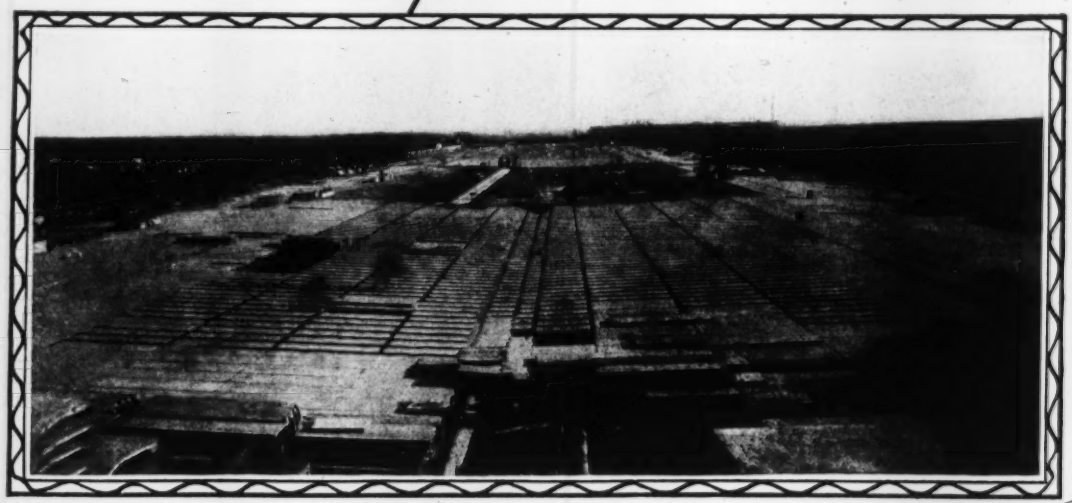
Irrigation Works Construction in Mexico

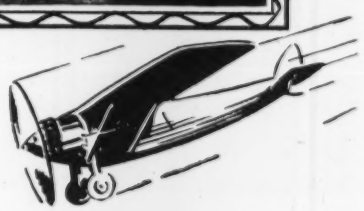
Steel Frames for Houses—First of Three Articles



Upstream Face of the Salt Springs Dam on the Mokelumne River in California

This Roof on the New DETROIT Municipal AIRPORT HANGAR





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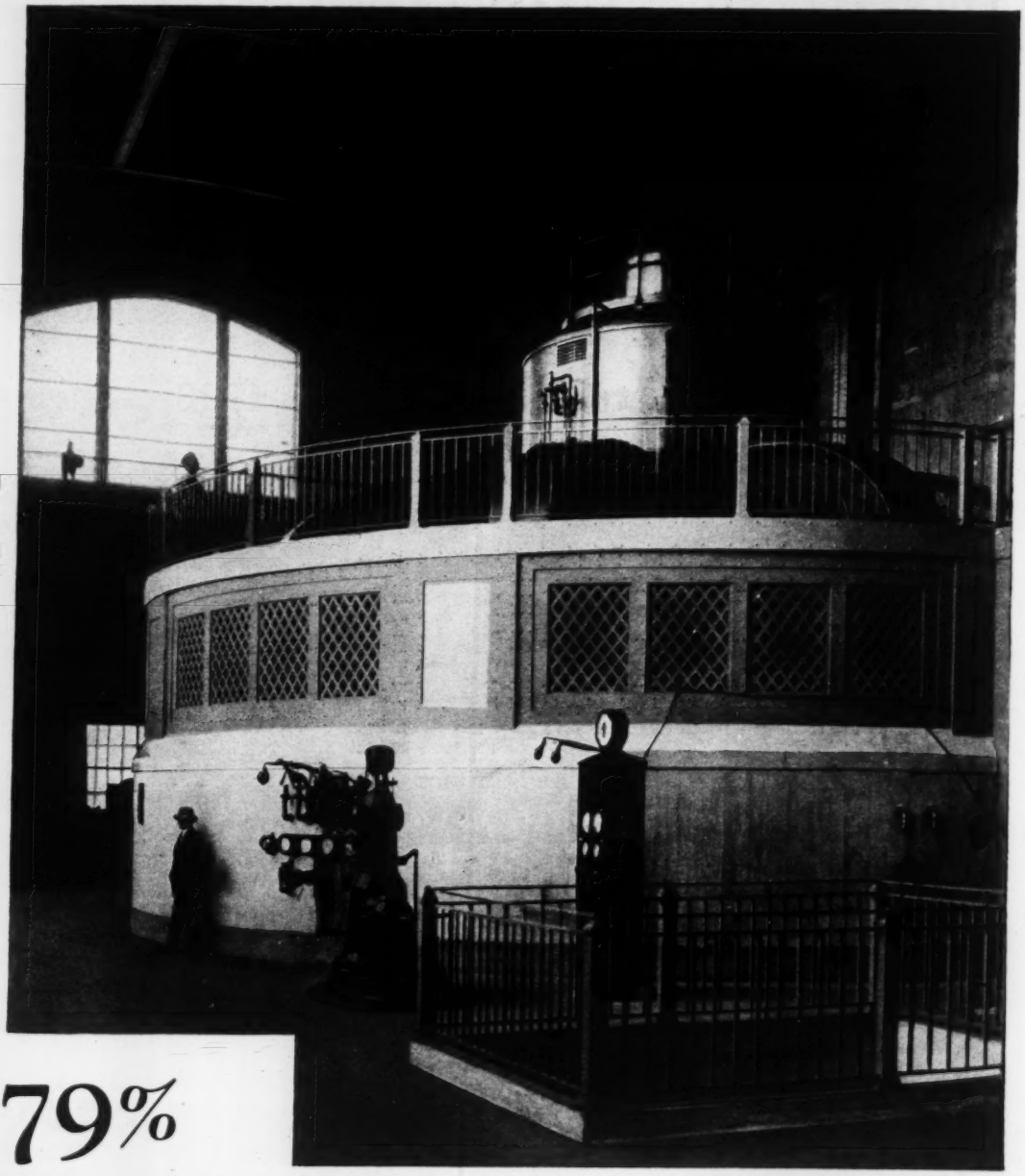

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 104 NEW YORK, JANUARY 16, 1930 Number 3

Dividends Through Foresight

CAREFUL study and foresight in planning and planting the construction job rarely fail to pay dividends to the contractor. An example of this appears elsewhere in this issue in an article written by a Los Angeles contractor describing two efficient concrete plants used in widely different situations. On the big job usually much thought is given to plant arrangement for maximum efficiency, but on the smaller job the contractor is prone to use whatever equipment happens to be handy and arrange it on the work without much thought as to its efficiency. Modern construction, highly competitive, is depending more and more on plant efficiency and job planning for profits on the work. To be successful, the contractor must make the plant fit the job and not fit the job to the plant. Well-planned jobs with suitable and efficient plant are not mere circumstances—they are the result of careful study and foresight, and furthermore, they are the jobs most likely to provide profit to the contractor.

New Utility Law

ADDITIONS of significance are made to the law concerning the rights of utilities by the decision in the Baltimore street-railway case, rendered last week, but how permanent these additions will be is less obvious. New doctrines are set up by the court covering two major points: one, that depreciation allowances are to be computed in terms of present value; the other, that in so uncertain a business as street-railway operation, with a credit poor enough to call for interest rates of 7 per cent or more on borrowings, a net income of 6.26 per cent (on total valuation!) is "clearly inadequate," and that income of 7.44 per cent as asked by the company should be allowed, though possibly a demand for 7½ or even 8 per cent might not be excessive. In these points the court establishes novel conditions. It waives aside recognized accounting principles on depreciation, as is keenly illuminated by Justice Brandeis in a dissenting opinion; and it accords to a protected industry an assurance of income far higher than either private business or the private citizen enjoys, though they lack the position and protection of monopoly. The court itself indicates, so far as can be read out of its sibyllic utterance on adequate return, that it might not be willing to allow so large a net income to railroads or other utilities. In general, its finding seems to rest on sympathetic recognition of the risky nature of the street-railway business; it emphasizes the risk repeatedly, and it mentions the declining traffic of the Baltimore lines. To prescribe higher rates as a cure for declining business is rather out of match with ordinary business judgment, and conceivably it may be an ineffective cure. But the details of the Baltimore case aside, the puzzle which the decision places before utilities and public alike is how far the reasoning of the opinion applies to all utilities, and to declining as well as rising price levels. It is a puzzle which further complicates the vast riddle which the Supreme Court has built up by its piecemeal and often conflicting decisions in rate and regulation matters, and which is likely to remain until the court courageously and with vision undertakes to frame a set of principles on which utility practices can be based.

Fares Charged on Franchise Values

ONE point in addition to the depreciation and fair-return features of the Supreme Court decision in the Baltimore street-railway case is of moment: the refusal of the majority of the court to question the inclusion of franchise value (the court calls it "easement value") in the property valuation on which the public must pay fares. This refusal is, says the court, because the protest against inclusion of franchise value comes too late, though it gives the protest a backhanded slap by the remark, "if it ever had substance." The technical point amounts to some five million dollars in seventy-five million, and affects the real financial meaning of the rate of return proportionately; yet, though the court weighs the adequacy of the rate of return, it declines to consider an element which is bound to have bearing on the adequacy of the rate. A lawyer may be able to appreciate the reticence of the court in this regard, but from the viewpoint of the layman it would appear to involve that kind of supercautiousness which in ordinary life often leads into error. A good deal of future litigation is likely to grow out of this matter. But more important still, it will trouble and divert the currents of thought in respect to healthy utility finance, which in recent years have been setting consistently toward a base of sound, practical engineering principles of accounting. Some utility men themselves, we believe, are not ready to go with the court in its attitude toward these franchise values. In so far as the court's action in basing returns on franchise value places excessive demands on the customers of the utility, it will react against good relations between the parties and so will in time call for readjustment.

Refuse Handling in Europe

CIVIC-MINDED Americans returning from abroad are likely to report that the streets there are much cleaner than here and that we are behind not only in street-cleaning methods but also in the collection and disposal of refuse. Such conclusions, for the most part, are by the very nature of the case based on general impressions rather than on concrete facts, expressed in terms of comparative statistical data. Elsewhere in this issue some observations of a Montreal engineer relating to European cities are presented. They are expressed in more concrete terms than many of the reports brought back to this side. Most of the space in Mr. Morssen's article is devoted to the collection of refuse. His text and illustrations are sufficiently concrete evidence that a number of cities in Germany, with the capital of Austria

added, are taking much pains to provide house cans and collection vehicles so built as to prevent effectively the scattering of refuse on the streets and the spread of dust through the air. What obstacles other than cost prevent the use of such cans and trucks in the United States and Canada Mr. Morssen does not discuss. He does give some data on installation and operation cost in Frankfort. The article as a whole will repay study by American engineers and city officials.

Fabricating or Building

ARE production methods applicable to house building? The issue has been with us for a long time but still remains without satisfactory answer. It concerns cost as well as quality-efficiency, for both offer opportunity for improvement. The best-built house compares but indifferently with a high-grade automobile in perfection of workmanship, and in the ordinary grade the comparison is even less reassuring. A decided gain in quality as affecting both service value and durability may confidently be expected through an approach to fabricated production methods in the field of house construction. However, the possible savings in cost and time are far more important. The hand methods of cutting and fitting which characterize house building are slow and expensive; they may be compared to the methods with which engine and machine construction struggled half a century ago and whose replacement by systematic fabrication and assembly gave momentum to the vast progress of industry since that time. Basically, therefore, the question is whether house building can be transformed from a poorly organized craft into an industry. A review of the problem, written from the vantage point of years of observation, begins in this issue. Its purpose is to direct wider attention to the problems involved, and to focus upon it the experience and thought of all those whose discussion can further the problem. Aside from design and construction practices, the peculiarities of different materials with respect to their fabricating possibilities are extensively involved. Present obstacles and resistances to a change are great, and threaten to delay it until an abrupt revolution of method comes about. By active study of the subject, however, an earlier start can be made and the sudden change replaced by progressive evolution. Contributions of opinion or fact bearing on the subject will therefore be particularly welcome.

Sewage Utilization

UTILIZATION of sewage is being given renewed attention. Three main forms are in evidence: *First*, use of the entire volume of sewage on land for its fertilizing or its moisture value or both; *second*, use of sewage solids for fertilizing value; and *third*, use of treated sewage for industrial purposes as a substitute for natural water. Last week we outlined in our news section the proposed industrial use of Los Angeles sewage—presumably after fine screening—and noted that the city is to make studies of further utilization in industry and agriculture. In the same issue there was a description of the use of the sewage of Vineland, N. J., on a sandy farm owned by it but leased to an operator, in connection with which studies are being made by the U. S. Department of Agriculture. This week we give an account of the use of treated sewage from resort hotels and camps at the Grand Canyon of the Colorado River for boiler feed and other purposes. At Sheffield, England, treated sewage is sold by the sewage department to the city gas department for use at the gas works; and, more notable, sewage-works effluent, under special conditions, is further treated at Sheffield and pumped upstream for miles to a point below a city water-works storage reservoir, as a substitute for "compensation water" to riparian owners below the point of stream diversion. A few American and British cities sell ordinary sludge from sewage-works for use as a fertilizer. At Milwaukee and two or three other places excess sludge from the activated-sludge process is being dewatered to 10 per cent moisture or less and sold as a fertilizer. This is a significant group of facts. They suggest that, even though most of the sewage farms and most of the attempts at sludge utilization the world over have been abandoned, there yet is excellent reason for looking forward to extensive sewage utilization. The present experiences should be studied, however, and supplemented by local experimental work before new attempts are made.

Reducing Noise by Absorption

IN FURTHER considering the growing agitation against noise as an enemy of human efficiency and comfort it is necessary to bear in mind the two directions of possible attack on the evil: noise prevention and noise absorption. Noise prevention has almost sole attention in public discussion and is perhaps the more necessary, but in many practical cases far greater results can be obtained through absorption. Sound transmission within buildings is an important part of the agencies by which noise comes to influence the day's work, and in so far as this transmission can be reduced by proper use of sound absorbents a material improvement in conditions is within reach. This possibility, for example, received special notice in a noise-reduction memorandum recently issued by the health commissioner of New York, who organized one of the current campaigns against noise. Even though we may long be powerless to check the growing chorus of noises that fills our streets, yet much may be gained if the living and working spaces in home or office can be made quieter. Herein lies the value of the increased attention now being devoted to sound absorption, of which Professor Watson's studies, summarized this week, give evidence. The subject extends into the field of both architect and engineer—the latter being concerned in the quantitative aspect of the problem. Its future development, one may judge, will go far beyond that yet reached. It commends itself to the engineer's attention as a matter for study.

Construction Money

THE satisfactory sale of a large block of Tennessee highway bonds, $29,000,000, is due to several causes not unknown to financial houses but too often ignored by public officials. In the first place the governor of the state was wise enough to do a whole year's financing at one time, making the issue big enough to give any syndicate that underwrote it sufficient profit for adequate advertising and expense of selling and underwriting. Second, he did plenty of shopping around, and finally he appealed to the local pride of his own home-state financial interests; the local bankers submitted a better bid than New York houses—a fact quite in line with a contractor's recent experience, indicating that Mid-South financial houses apparently have outlets for paper not enjoyed by New York, Detroit or Chicago bankers.

This state of affairs brings to mind some related facts, applying particularly to small issues and bonds of special character. Conditions in Chicago, for example, are such as to make 6 per cent special assessment bonds with which contractors were paid last summer (at 94) not salable at any reasonable figure now. Contractors who have carried these bonds with a view to marketing them as needed to finance this season's work find the situation difficult. Its effect is to penalize some of the most substantial firms.

The facts taken together prove that money for public improvements is available, but that sound and well-judged financial procedure is essential for the best results. If the financing is at all out of the ordinary, heavy discounts may have to be faced—the price which some contractors must now pay as an after effect of last fall's stock-market collapse.

The Toledo Sewage-Treatment Award

LAKE states consulting engineers are rejoicing over the outcome of a sanitary battle that has been going on for half a year in Toledo. Engineers generally may join in the rejoicing, because the conflict was of a kind that has been waged over a wide range of country for many years past—sponsors of proprietary processes or apparatus trying to force in their wares after engineers' plans for some other method had been adopted.

Since 1916 Toledo has been engaged on a comprehensive plan looking toward collection and treatment of its sewage wastes with a view to abating nuisances in its two watercourses. The general plan provided for intercepting sewers to convey the sewage to a treatment plant near the mouth of the Maumee River. Pending the construction of the treatment plant, pumping stations at the ends of the interceptors on either side of the river have been discharging the raw sewage directly into the river. The west side system, costing $3,500,000, was put into operation in 1925; the east side sewer, which with a treatment plant to serve both sewers will cost $4,500,000, has been completed only recently. Meantime the planning of the treatment plant was started.

Careful consideration was given to type of treatment capable of maintaining sanitary conditions in the lower river and bay, protecting fishing and bathing and providing against pollution of a possible future water supply from Lake Erie. Consulting engineers retained by the city concluded that sedimentation, complete digestion of the sewage solids and chlorination of the liquid wastes would be necessary. Either Imhoff tanks or one-story tanks with separate sludge digestion would fulfill the requirements; estimates showed that the latter would be the more economical under the local conditions, and they were adopted.

Plans were made, the city submitted them to the state board of health, the latter approved them, and the city then called for bids. This was in June, 1929. The bids were rejected as too high; back of the rejection was the fact that advocates of screening the sewage had persuaded certain city officials that the specifications should be opened to this lower type of treatment. In August, without asking the approval of the state board of health, the city authorities called for bids on contractors' designs using screens, as well as for bids on the consulting engineers' designs. The lowest bid was for screens, but was submitted by a competitor of the concern that induced the authorities to open the bidding to screens. After the bidding the design for a screen plant was submitted to the state board of health for approval.

In the meantime the health officials of states bordering on the lakes, signators in 1928 to the Great Lakes Drainage Basin Sanitation Agreement, had met during the convention of the American Public Health Association at Minneapolis and had amended their original agreement to provide that minimum treatment shall be "efficient sedimentation." Backed up by this resolve and in conformity with previous approvals of tank treatment, the Ohio State Board of Health refused to approve the plans of the screen treatment plant.

Finally, after much jockeying back and forth, a contract was let for the plant as designed by the consulting engineers, to the lowest of the bidders on the sedimentation process. Telling arguments for the tank process were the relative clarifying efficiencies and the relative clarifying costs (per unit removal) of the two methods. Screens, it was shown, remove from 5 to 15 per cent of sewage solids, while tanks remove 50 to 70 per cent. Screens require a plant cost of $60,000 to $180,000 for each 1 per cent removal, while the tank treatment requires $20,000 to $30,000 of plant for the same result—construction cost in both cases being based on the August bids.

Out of all this discussion, which intentionally omits the bitter political aspects of the case, comes the conclusion that manufacturers of apparatus and advocates of processes giving lower performance than is considered essential by engineers after careful, conscientious study are working against their own best interests when they attempt to force in their product. The time to promote processes and apparatus is during the preparation of the plans and not after bids have been received. The sewage field seems beset by those who are continually confusing public officials by offers to substitute one process for another regardless of the performance factor. There is a place for screens, and consultants frequently recommend them; but where conditions indicate a need for three or four times their efficiency, why try to sell them?

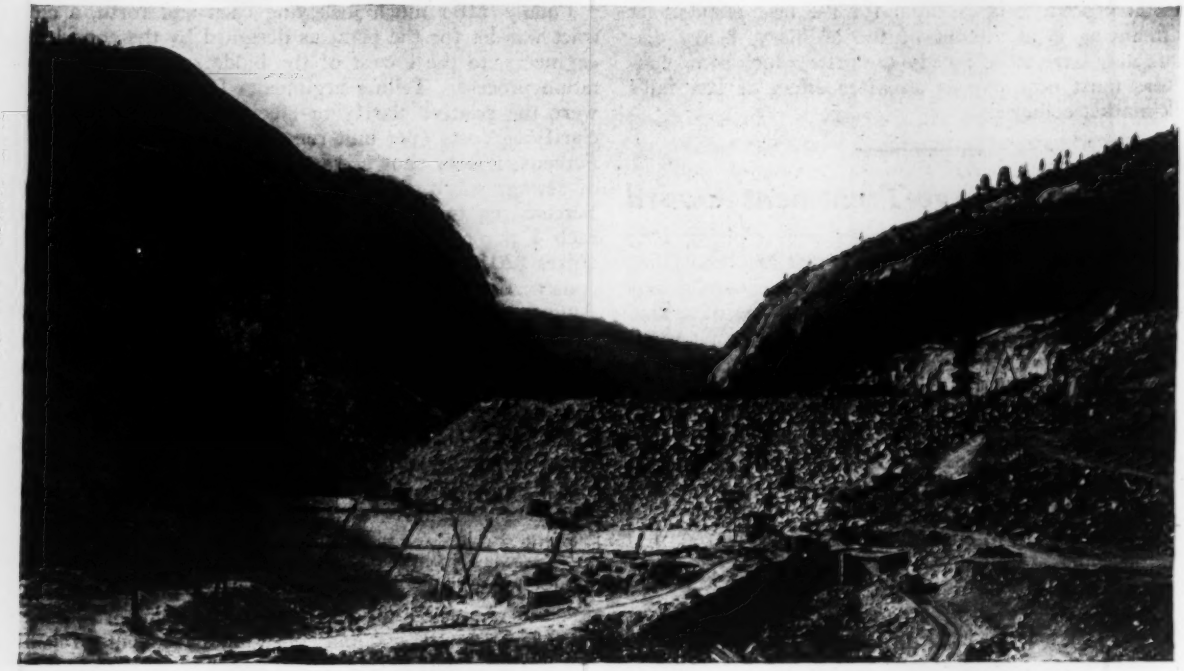
If this Toledo case were the only one where the methods criticised had been followed, there would be less, though sufficient, reason for condemning them. Like attempts have been made elsewhere—most notably at Cleveland years ago, and there was one at Syracuse somewhat later. In both cases, desperate efforts were made to force in screens after plans for other and more complete methods of treatment had been drawn by competent engineers. The end was defeat, as recently in Toledo. Similar campaigns, also unsuccessful, were conducted in behalf of the direct-oxidation or lime-electrolytic process at Lima, Ohio, and Trenton, N. J., to name but two places, only in these cases there were serious questions as to the advisability of using the processs under any condition, whereas the screens at issue have been long and widely accepted as rightful competitors with other screens where fine screening was considered desirable by disinterested engineers. The lime-electrolytic process has almost faded from the picture of late—apparently completely so as regards highly objectionable promotional measures.

Relations between manufacturers and engineers in the sewage-treatment field are not sweetened by their experiences at Toledo and elsewhere. Sales resistance is only built the higher, and the sooner the manufacturer who practices such measures realizes that fact the less red ink he will find on his ledger and the more rapid will be the progress of sewage-works construction.

High Rockfill Dam Designed With Jointed Concrete Face

Plans for Salt Springs Dam in California 328 Ft. High Include Curved Upstream Face to Provide for Settlement

By I. C. Steele
Chief of Division of Civil Engineering
Pacific Gas & Electric Company, San Francisco, Calif.



UPSTREAM FACE OF SALT SPRINGS DAM
Fill from spillway excavation at left, main quarry fill at right. Note derricks building placed rock sections and recesses left for concrete ribs.

THE Salt Springs dam is a rockfill structure now being built by the Pacific Gas & Electric Company to store water on the Mokelumne River in California for hydro-electric purposes. Because of the unusual height for a dam of this type, 300 ft. above streambed and 328 ft. above lowest foundation, great care was used in determining side slopes as well as in the selection of materials and method of construction. The inaccessibility of the site and the ample supply of excellent granite rock that was available determined the selection of the rockfill type dam as best suited to the location. The concrete facing is being laid in panels 60 ft. square with the joints supported on concrete ribs in the placed rock section. The alignment of this upstream face forms a warped surface designed with a view to providing maximum protection against cracking when expected settlement of the fill occurs. The work is being done by the construction forces of the company, which eliminated the necessity of completing plans and specifications before work was started. As a result it has been possible to modify the plans from time to time as new aspects developed during construction.

Use of the Storage—The Salt Springs dam will impound 130,000 acre-ft. of storage to supplement the natural flow of the Mokelumne River and make increased power production on this stream economical. Immediate results of this increase in storage will be the construction of two new plants and the rebuilding of an existing one. The flow of the river regulated through the reservoir will pass through the new Salt Springs power house, to be built near the foot of the dam; the head at the plant will be approximately that produced by the structure. Immediately below this plant the water will enter an 18-mile conduit and be dropped back into the river through Tiger Creek power plant (1,220-ft. head), a new development to be constructed at an early date. From the discharge of this plant the water will be rediverted and used through the completely rebuilt Electra plant.

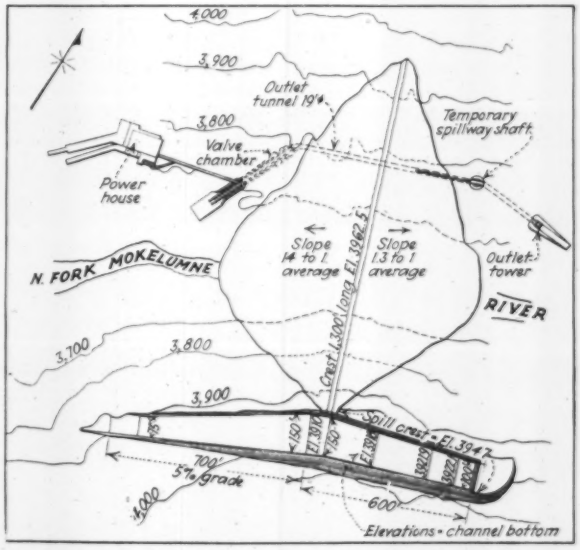
The development outlined will amount to an increase in power capacity of 146,000 kva., and proposed additional storage on the Bear River (the main tributary of the Mokelumne) will make possible a subsequent increase of 25,000 kva. With the completion of this latter development the river will be utilized to the practicable limit of its power-producing capacity with the exception of some minor storage sites.

Economic development of this project depended upon the cost of storage at the Salt Springs site. The location is approximately 50 miles from a railroad, 40 miles from existing power lines and about 30 miles from a main highway. The inaccessibility of the site combined

PLACED ROCK READY FOR CONCRETE SLAB
Slope of upstream face averages 1.3 horizontal to 1 vertical.

with the unlimited amount of excellent granite easily obtainable suggested the economy of a rockfill dam during preliminary considerations. This type of structure would require the least amount of transportation, which would reduce materially the item of maintenance cost of construction road, since a railroad to the site was beyond consideration. Detailed cost studies of various types of concrete structures verified the preliminary estimate and plans were adopted for a rockfill dam consisting of loose rockfill with the upstream section derrick-placed and covered with a slab of reinforced concrete.

The general features are, therefore, similar to other modern structures of this type, but because of the unprecedented height and size of the Salt Springs dam, exhaustive design studies were made; these developed interesting details, particularly in regard to the construction of the facing and the provisions for settlement. The slope of the downstream face is 1.4 horizontal to 1 vertical, and berms as shown in the accompanying section will be constructed to provide this slope if it is

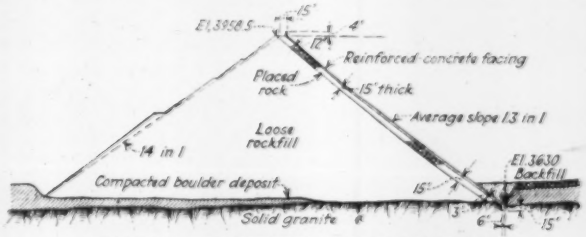


PLAN OF DAM SHOWING SPILLWAY AND OUTLET WORKS

not secured by the natural angle of repose of the rock as dumped. The average slope of the upstream face will be 1.3 horizontal to 1 vertical; the details of this front slope profile are discussed later. Top width will be 15 ft., and at the maximum section the height of 328 ft. to lowest foundation will give a total thickness at the base of approximately 900 ft. Length of crest is 1,300 ft., and the total volume of the dam is approximately 3,000,000 cu.yd.

The loose rockfill, which constitutes about 93 per cent of the total volume of the dam, consists of quarry run granite, the maximum size of material being determined by the capacity of the equipment. The fill resulting from spillway excavation, hauled by crawler tractor-trailer outfits, contains rocks up to 2-cu.yd. size. The main quarries have railroad equipment which transports rocks up to 8-cu.yd. size. Provision is made for washing the loose fill with streams of water after dumping.

The derrick-placed rock section covers the entire upstream face and is 15 ft. thick measured perpendicularly to the face. It is laid up of large rocks with the spaces chinked with smaller ones to present a continuous sur-



SECTION AT MAXIMUM HEIGHT OF DAM

face and adequate backing for the concrete facing. No specifications for this placed rock section are used, but care is taken to see that the section is solid and well packed. The lower edge of the placed rock rests on solid granite along the entire upstream toe. The entire site was stripped to bedrock with the exception of the downstream portion of the streambed, where a thoroughly compacted deposit of boulders and gravel was used as a foundation for the rockfill.

Trenches in the placed rock are provided at 60-ft. intervals both horizontally and down the slope for concrete ribs to support the edges of the square sections of concrete facing slab. The horizontal depressions (see detail) are triangular in section, having a 2-ft. vertical back and a 5-ft. face on the slope as their minimum dimensions; the floor is horizontal. This section was selected to facilitate the erection of the derrick-placed rock. Incidentally they provide convenient walkways during construction. The vertical trenches are rectangular in section, 4 ft. wide and approximately 2½ ft. deep. This system of recesses is filled with concrete before the facing slab is poured and is mopped with hot asphalt to prevent bond with the facing.

Concrete Facing—A reinforced-concrete paneled slab varying from 3 ft. thick at the bottom to 1 ft. at the top provides the waterproof facing at the upstream face. At the toe this slab extends downward to form a vertical cutoff wall 6 ft. wide with a maximum depth of 15 ft., according to the design, although this depth has been exceeded in several places because of rock conditions to insure proper cutoff. Grout holes 50 ft. deep below the bottom of the cutoff trench are provided at 6-ft. intervals along the section of the dam where the height is over 200 ft. On the two sides of this section the grout holes are 10 ft. apart and the depth is de-

TABLE I—SLAB THICKNESS AND REINFORCING

Elevation	Depth	Slab Thickness	Reinforcing Size	Reinforcing Spacing Horiz.	Reinforcing Spacing Vert.	Position of Reinforcing
3,958 5	0	1'- 0"				
3,921 5	37 0	1'- 3"	1" sq.	1'- 1"	1'- 1"	Center of slab
3,884 0	74 5	1'- 6"	1" sq.	11"	11"	Center of slab
3,847 5	111 0	1'- 8½"	1" sq.	10"	10"	Center of slab
3,812 0	146 5	1"-11½"	1" sq.	9"	9"	Center of slab
3,777.0	181 5	2'- 2"	1" sq.	8"	8"	Center of slab
3,743.0	215 5	2'- 4½"	1" sq.	7½"	7½"	Center of slab
				1'-2½"	1'- 2½"	Two rows at El. 3,763
3,710 0	248 5	2'- 7"	1" sq.	1'- 1½"	1'- 1½"	Two rows
3,663 0	295 5	2'-10½"	1" rd.	9½"	9½"	Two rows
3,630 0	328 5	3'- 1"	1" rd.	9"	9"	Two rows

creased gradually from 50 ft. to a minimum depth of 25 ft. at crest line.

The facing is reinforced near the bottom of the deepest section with two layers of 1-in. round bars at 9-in. centers in both directions. The amount of reinforcing gradually reduces to a single layer of 1-in. square bars spaced 1 ft. 1 in. in both directions at the crest of the dam. The gradation of the slab thickness and the amount of reinforcing are given in Table I.

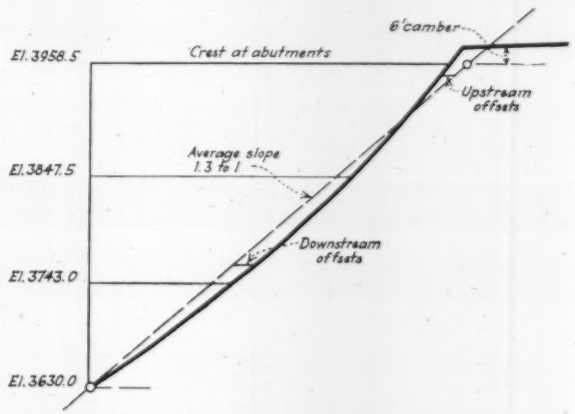
To allow for inequalities in settlement, the slab is built in 60-ft. square sections connected by construction joints filled with asphaltic material and fitted with copper water stops. The edges of these sections rest on the concrete ribs previously described. Typical designs of the horizontal and vertical joints, as to the stopping of the reinforcing and the location of the water seals, are shown in the accompanying details. The horizontal copper seals stop at the joints and a short auxiliary piece is welded to the ends and the vertical seal at each break to make the water stop continuous.

The angle where the concrete facing connects with the vertical cutoff trench presented a problem, because settlement of the fill at the toe would tend to produce a crack along this line. To provide a more gradual transition in the support for the facing from the solid rock to the fill, a section of the placed rock along the toe was filled with mortar. This will give a semi-rigid backing to the slab below the flexibility introduced by the lowest construction joint.

Provisions for Settlement—Based upon the best existing data on settlement in a rockfill structure, the upstream face and the details of the facing were designed to take care of such settlement with the introduction of the least amount of stress in the slab. Estimated settlements due to the weight of fill when combined with the probable settlement due to water pressure were used to calculate the type of warping to be introduced in the upstream surface. The face was arched upstream in plan, such that after final settlement had taken place it will still retain a horizontal convexity. This feature will tend to prevent tension cracks in the slab and at the joints. Sufficient space between panels will permit the necessary horizontal shortening without introducing undue compressive stresses in the slab. The horizontal convexity amounts to 6.5 ft. at the crest and diminishes proportionately with the depth.

The face is concave, considering a vertical section parallel with the river, and is being constructed so that concavity will still exist after final settlement. The lateral thrust due to the weight of the concrete will be against the rockfill at all times and there will be no tendency toward buckling, as would be the case were the facing convex in section.

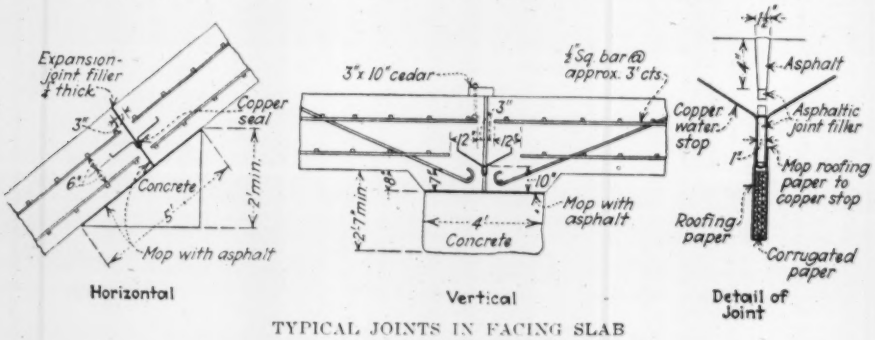
The position of each panel corner in this system of two-way curvature is calculated and construction work on the upstream face is laid out accordingly. The accompanying table shows the horizontal offsets for locating the face in respect to the average slope line of 1.3 to 1. This method of laying out the upstream face gives a record of the curvature introduced at 60-ft. intervals in both directions, and a series of future measurements is planned to determine the actual settlement over a period of years as compared with the estimated settlement.



SECTION THROUGH UPSTREAM FACE, SHOWING CURVATURE

Amounts of curvature at various elevations are given in Table II.

Spillway and Outlet—Temporary provision for bypassing streamflow during construction was made by driving a 19-ft. diameter tunnel under the north abutment of the dam; this tunnel later will be used for a permanent outlet. The tunnel has a diameter of 19 ft. inside the lining and a total length of about 1,100 ft. in solid granite, of which distance approximately 900 ft. is lined with unreinforced concrete with an average thickness of 18 in. After the lining was poured a lapse of 60 days was allowed for shrinkage, followed by grouting under a pressure of about 100 lb. per sq.in. Grout holes were left in the lining at 10-ft. intervals and these holes took an average of approximately 5 cu.ft. of grout per linear foot of tunnel. The upper end of this tunnel terminates in a vertical section of reinforced concrete topped by a steel trash rack 25 ft. high and 21 ft. square in plan. The tunnel is designed for continual pressure operation with control works near the lower end, where the section will be enlarged to provide space for two 11-ft. butterfly valves controlling the flow into two 10-ft. diameter steel pipes 200 ft. long, another outlet being through



TYPICAL JOINTS IN FACING SLAB

TABLE II—HORIZONTAL OFFSETS FOR LAYING OUT CURVATURE OF UPSTREAM FACE

(Expansion joints between panels in slab are at 60-ft. intervals)

Stations	0+40	1+00	1+60	2+20	2+80	3+40	4+00	4+60	5+20	5+80	6+40	7+00	7+60	8+20	8+80	9+40	10+00	10+60	11+20	11+80	12+40	13+0
Elev. crest	3,958.5	3,958.7	3,959.0	3,959.8	3,960.7	3,961.5	3,963.3	3,964.2	3,964.4	3,964.5	3,964.1	3,963.0	3,961.8	3,960.5	3,960.2	3,960.0	3,959.6	3,958.8	3,958.7	3,958.6	3,958.5	3,958.5
Crest	—0.1	—0.4	—1.2	—3.0	—5.0	—7.5	—10.9	—12.8	—13.4	—13.6	—12.6	—10.2	— 7.5	—5.3	—4.0	—3.3	—2.5	—1.2	—0.5	—0.3	—0.1	0
3,921.5	.....	5.9	5.3	3.9	2.1	0	—2.8	—4.4	—4.8	—5.2	—4.1	—1.9	0.2	2.0	3.0	3.6	4.4	5.3	5.8	6.0	.....	.....
3,884.0	.....	.....	10.6	9.4	7.8	5.5	3.3	1.8	1.4	1.1	2.0	4.1	6.1	7.5	8.5	9.1	10.0	10.7	11.0	.....	.....	.....
3,847.5	.....	.....	14.2	13.2	11.8	9.8	7.7	6.3	5.9	5.6	6.5	8.5	10.3	11.6	12.5	13.0	13.9	14.2	.....	.....	.....	.....
3,812.0	.....	.....	.....	15.7	14.4	12.6	10.7	9.5	9.0	8.7	9.5	11.5	13.1	14.2	15.0	15.5	.....	.....	.....	.....	.....	.....
3,777.0	.....	.....	.....	.....	15.6	14.1	12.4	11.2	10.7	10.4	11.3	13.2	14.6	15.6	16.2	.....	.....	.....	.....	.....	.....	.....
3,743.0	.....	.....	.....	.....	15.2	13.8	12.4	11.3	10.9	10.5	11.3	13.1	14.4	15.2	.....	.....	.....	.....	.....	.....	.....	.....
3,710.0	.....	.....	.....	.....	.....	12.7	11.1	10.2	9.6	9.3	10.1	12.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3,663.0	.....	.....	.....	.....	.....	.....	6.5	6.0	5.7	5.3	6.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3,630.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Note: Values in table within heavy lines are offsets measured upstream from the 1.3 to 1 line. All other values are offsets measured downstream.

free-discharge valves into streambed below the dam. Water for the Salt Springs power house, to be built directly below the dam, will be drawn from one of these steel pipes. The plan of operation under ordinary conditions will be to leave the butterfly valves open and keep the free-discharge valves at the end of the two pipe lines closed, discharge being made to the power house. In case of emergency the valves at the end of the pipe lines can be opened for rapid drawdown of the reservoir. The butterfly valves in the tunnel provide for an emergency shutoff in case of accident to any of the lower valves. About 6,500 sec.-ft. of discharge with full reservoir is provided by the two pipe outlets. Water passing through the power house enters the conduit leading to the new Tiger Creek plant.

The spillway is of the side channel type, excavated in solid granite around the south abutment of the dam. The overflow crest is 650 ft. long and is 15.5 ft. vertically below the crest of the upstream facing. With maximum flood of 48,000 sec.-ft. the flow over the spillway lip would be 7.5 ft. deep, leaving a freeboard of 8 ft. Such a flood would require a runoff of 300 sec.-ft. per square mile for the 160 square miles of drainage area, or 3½ times the maximum flood of record. Spillway discharge is carried about 750 ft. in a trough of excavated rock with a 5 per cent grade and then returned to the riverbed.

Organization—A. H. Markwart, vice-president in charge of engineering, Pacific Gas & Electric Company, is responsible for the major features of the project. Designs were prepared by Walter Dryer, assistant chief of the division of civil engineering, and the author, in collaboration with J. D. Galloway, consulting engineer. G. C. Green is field engineer. Construction is under the supervision of O. W. Peterson, engineer of general construction.

Responsibility for Ogden's Typhoid Outbreak Placed Upon Infected Milk

Fourteen cases of typhoid fever resulting in five deaths in Ogden, Utah, during the two weeks June 20 to July 4, 1929, occasioned a news item in *Engineering News-Record* of Aug. 16, 1929, p. 272. As reported in that issue, the state health commissioner, Dr. E. E. Beatty, submitted a preliminary report on the appearance of typhoid in which he concluded that it had been due to a contamination of the water supply through the use of the flow from Wheeler Creek. A report presented to the Ogden board of commissioners by J. E. Greaves, professor of bacteriology of the Utah State Agricultural College, and L. L. Daines under date of Aug. 12, 1929 (greatly delayed in reaching *Engineering News-Record*), holds that milk was the vehicle of infection. It urges that the limited number of cases (fourteen out of 30,000 to 40,000 using the water supply) is inconsistent with a water-borne epidemic.

All those who contracted the disease, the report states, had eaten at lunch stands which had a common milk supply, delivered in cans which were interchanged among them. The records show that a waiter at one of these lunch counters was ill during the latter part of May and the first part of June, and subsequently gave a positive blood Widal test for typhoid. He had had typhoid fever some 45 years previously and his illness just prior to the epidemic, the authors of the report say, may have been typhoid fever in a mild form due to a certain degree of immunity carried over from his previous attack or due to his being a carrier.

Steel Frames for Houses

Three Articles Analyzing the Problem and Proposing a Course of Procedure That Will Modernize the House-Building Field

By T. J. Foster
Chairman, National Bridge Works, Long Island City, N. Y.

I—The Situation Today

A review of twenty years' effort in the field of a primitive art reveals that some dozens of houses utilizing steel frames have been built as individual undertakings but that no one type has been successful in achieving popularity.

SMALL house construction commands a prominent place in industry from the standpoints of volume and sociological importance, but it has been marking time for a generation. The methods used are antiquated and inefficient. Some houses are made from rough sketches drawn on paper or on boards, and for most of them the material is shipped in its crude state to the building site, where the wood is cut with hand saws, the pipe is threaded with hand tools and the cutting and fitting of every element of construction is done in the slowest and most expensive manner.

Attempts have been made from time to time to inject new life and modern viewpoints of efficiency into the house-building field. The most promising proposal has been to use steel framework, a step which seems simple and promises to bring about a radical improvement in house construction. Yet despite this promise, only a few scattered steel-frame houses have been built.

Why has the steel-frame house failed to take after twenty years of promotion? Is it the fault of the steel frame or of the methods of promotion? Where do we stand now? What are the possibilities in the future? How should these possibilities be developed? These are some of the questions which this article and two subsequent ones will consider.

Shortcomings of Present House Building

The dwelling house is the great exception to the rule that the advancing years bring increased output of labor per day. After a careful survey the U. S. Department of Commerce places the waste in the building industry at 53 per cent, 34 per cent of which is chargeable to poor management, in turn a result of lack of simplification, inefficient methods and obsolete machinery. It estimates that this waste is two billion dollars a year. The percentage of waste is greater in small buildings than in large ones.

One of the Federal Reserve banks has compiled figures showing that the average cost of building materials is the same today as it was ten years ago, while the cost of building labor has increased 100 per cent. The laborer will not be getting his reward in house value until the methods of construction have improved in an equal ratio with the improvements in the methods of manufacturing building materials.

Too often the prospective house builder, who generally does not have the ability to discriminate between good and bad design, makes his selection of plans without competent architectural advice. He goes to the plan books produced by small house bureaus, by manufacturers of lumber, brick, stucco, etc., and by material dealers, in none of which is architectural merit a primary object. Probably more than half of all small houses are built without the aid of an architect. Many persons who do purchase good designs change them without an architect's supervision, usually with bad results as far as the convenience of the completed house is concerned—frail construction that hastens obsolescence, or architectural deformities that are offensive to the individual and detrimental to the community.

The outlook is equally grave from the point of view of the small house purchaser. He is the dupe of clever advertising and smooth salesmanship. For a few months after he takes possession the only financial

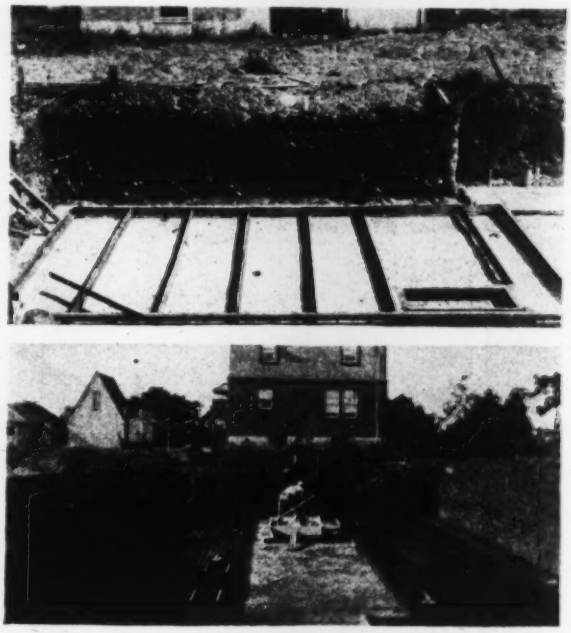


FIG. 1—HOUSE IN TEANECK, N. J., UTILIZING STEEL FRAME WELDED ON THE GROUND
Views show frame before and after wire lath is attached and before stucco is applied.

drains are payments on the first and second mortgages. Then the small amount of insulation in the house shows up in an unexpected outlay for heating; the poor paint and varnish give out and must be renewed. Unsightly cracks and their corollary, vermin, appear because the lumber is of poor quality and not well seasoned, expanding and contracting with the changes of weather. Poor and light materials make the house less fire resistant. Then comes the realization that this is the type of house on which the building and loan associations estimate the depreciation to be 10 per cent the first year, 9 per cent the second, and so on until in a few years 50 per cent is written off. It is impossible to pay for the house as rapidly as it depreciates in value.

For many years the owners of homes, the building and loan associations and the agencies working for better houses have been looking toward a time when steel

would play an important part in home building, even as it has played so important a part in the improved construction of other types of buildings. The realization has come that in steel we have a substance embodying strength and endurance, capable of being adapted to modern and efficient methods of production and sale and offering a new approach to the solution of the problem of building good homes at low cost. The adapta-

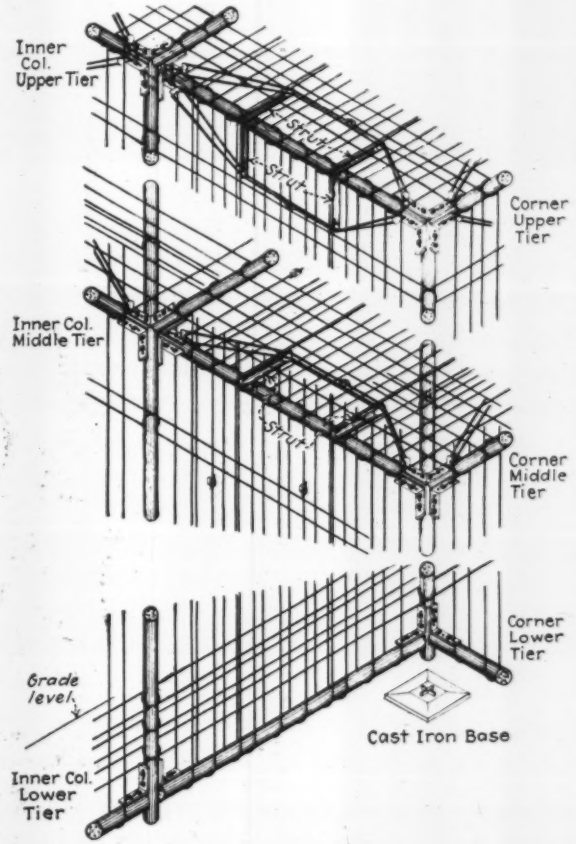


FIG. 2—DESIGN OF SUSPENSION STEEL CONCRETE COMPANY, 1909

Metal lath used over ceiling wires, under floor wires, inside the outer wall wires and outside the inner wall wires.

tion of steel to small house building has been tried many times, but apparently with little success.

The Naugle House—In 1907 the ambitions of a young engineer, Harry M. Naugle, of Canton, Ohio, prompted him to make an attempt at substituting steel for wood in the framing of a house for the employees of the Tuxedo Park Association. The "metal lumber," as it was called, was made by the Berger Manufacturing Company, of Canton, and the contractor was the Taft-Howell Company, of Cornwall, N. Y. The following description of this residence is quoted from an article in *Iron Age*, May 27, 1908:

A cement-plaster twin dwelling house has been erected at Tuxedo Park, N. Y., which accentuates the use to which metal and non-combustible material generally can be put in ordinary building construction. Perhaps its most interesting feature lies in the use of metal instead of wood for its framework. The method of construction is similar to what is known as wood balloon framing, but the structural parts consist of specially designed sheet-steel shapes made to serve as the uprights and the roof rafters, these shapes being given the name of metal lumber. The floors and roofing are made of what is known as ferrolithic plate, which is metal in a somewhat corrugated form, this metal being covered with concrete plaster as the wearing finish. The

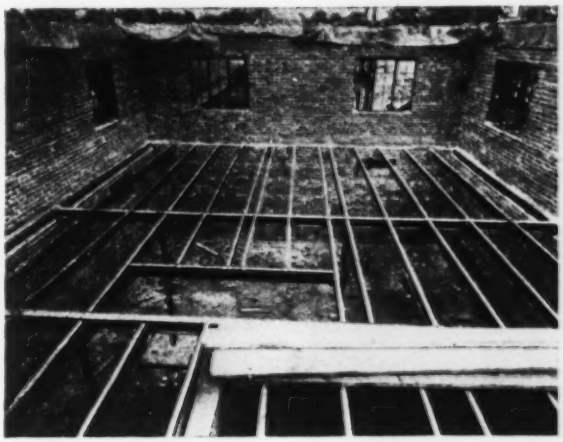


FIG. 3—JONES & LAUGHLIN BEAMS IN A GREAT NECK, N. Y., HOUSE

Similar beams were used in the second floor and for the roof.

exterior and interior surfaces of the building are concrete and plaster, respectively, and these are applied to expanded metal lath which is fastened in the usual way. The structure proper thus has no combustible material in its make-up with the exception of the wood trim.

The Naugle house was 24x60 ft., with two stories and basement. The steel contract included the steel studs for walls and partitions, the lath for the outside and inside of the walls, for both sides of the partitions and for the ceilings, the joists for the second floor and the roof, and the ferrolithic plates for the floors, roof and stairs. The building was of simple design, having no dormers or valleys. Its cost erected was $1,160. The building has remained in good condition.

Glencoe Houses—In 1909 the Suspension Steel Concrete Company built a house at Glencoe, Ill., using pipe for the structural support and metal lath for the exterior and interior walls, for the partitions and for the ceilings and floors (Fig. 2). It is reported that after ten years no cracks that can be attributed to structural inadequacy can be seen. Although this construction was used for 35 buildings, only a few of them were residences.

Dexheimer House—In the years following, steel frame houses of one and two stories were erected here and

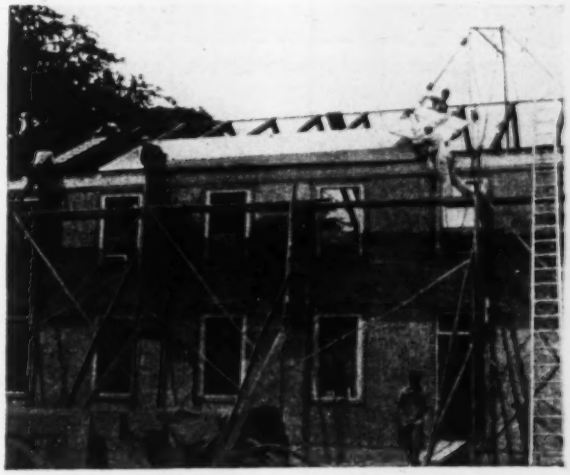


FIG. 4—APPLYING PRECAST GYPSUM SLABS ON A STEEL-FRAME ROOF

FIG. 5—STEEL-FRAME HOUSE WITH CORK INSULATION DEVELOPED BY THE JUNIUS H. STONE CORPORATION

there, but I cannot find that any two-story houses were being built for quantity use. Among the structures erected during this time were several by C. H. Dexheimer & Sons, of Toledo, which followed the Naugle method. According to report, the steel was used in exactly the same manner as wood is utilized in the frame of ordinary buildings. The exterior walls consisted of 4-in. pressed-channel studs spaced approximately 24 in. on centers, covered with a rib lath weighing 3½ lb. to the yard. The floors were 2-in. concrete reinforced with 4-lb. rib lath.

Later Attempts—About 1926 there seems to have been an increase in steel-frame house activity. One widely advertised was built at Tarrytown, N. Y., by J. C. Broderick, using standard units made from light angles for building up the frame. A departure in method, but not in the effect produced, characterized a house built at Teaneck, N. J., by James G. Dudley, in which the studs were welded to their connections and wire lath was used for walls and partitions (Fig. 1). The National Bridge Works furnished two floors (Fig. 3) and a roof of Jones & Laughlin junior beams for a house at Great Neck, L. I., and later for one at Jamaica L. I. A short time later this same organization furnished two floors and a roof for a building in Easthampton, N. Y., in which the beams, 4 ft. on centers, supported a 2¾-in. reinforced-concrete slab for the floors and a precast gypsum slab for the roof, as shown in Fig. 4.

In order to overcome the disadvantages of lack of insulation in steel-frame houses, the Junius H. Stone Corporation, New York City, inclosed the steel frames of a residence and of a parish house in Port Washington, N. Y., with cork slabs attached to the main frame by light angles (Fig. 5). Stucco was used on the exterior and plaster on the interior. This same organization also built some houses at Scarsdale, N. Y., using floor beams 4 ft. on centers with concrete joists between them 1 ft. 4 in. on centers. An expanded-metal lath was used under the joists and a double-wood floor on top of the joists. For the walls, 4-in. hollow cork-concrete blocks were used, covered with stucco on the exterior and 1-in. cork board and plaster on the interior. With this construction, the steel struts do not need to

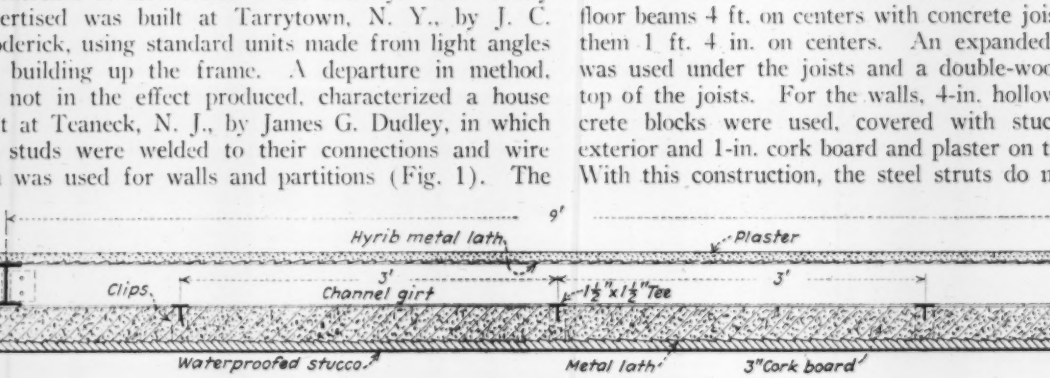


FIG. 7—DESIGN DEVELOPED BY THE STEEL FRAME HOUSE COMPANY, PITTSBURGH
Perforated members assist in erection.

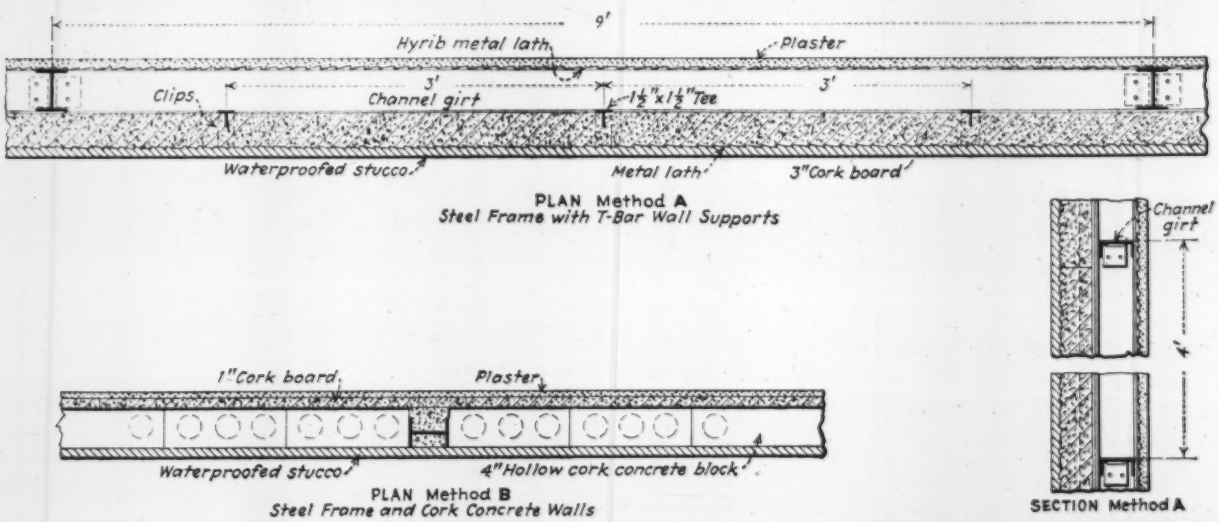


FIG. 6—DETAILS OF CORK AND STEEL CONSTRUCTION, JUNIUS H. STONE CORPORATION

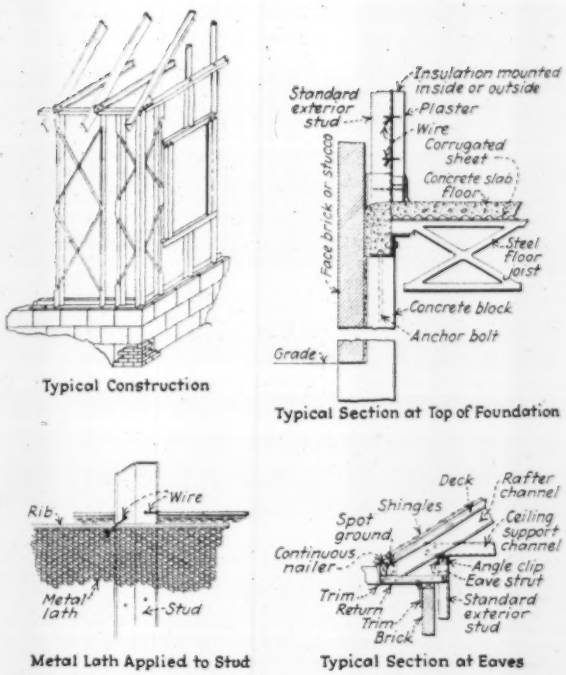


FIG. 8—STEEL HOUSE DETAILS OF THE WALTER BATES STEEL CORPORATION

Note that diagonal bracing is supplied by shearing and bending a portion of the outstanding legs of the vertical angles.

be so close together as in most of the other designs of steel-frame houses.

Although there has been little improvement in the art of using a steel frame in a small building since 1907, some of the larger steel interests are now rather belatedly realizing that there are possibilities for profit in "steel lumber," and we may see some real advancement made in the next few years. At any rate within the last three years a rolling mill and two steel fabricators have spent considerable money in planning, advertising and erecting steel-frame houses.

The Jones & Laughlin Steel Corporation built a bungalow at Woodlawn, Pa., in April, 1926, practically the entire framework of which consisted of its 6-in. junior beams, with the addition of a small amount of standard structural material. A 2-in. concrete slab floor was laid over paper-backed wire reinforcing material; 1x2-in. wood nailers were set in the slab 16 in. on centers and a wood wearing surface was applied. The exterior covering of the house consisted of three coats of portland cement stucco, $1\frac{1}{4}$ in. thick. The stucco was applied on a reinforcing material similar to that used for the floor slab, secured to the junior beams by means of lath clips. The interior partitions consisted of small pressed steel studs to which 24x32-in. gypsum boards were attached, with $\frac{1}{2}$-in. open joints left between the boards. A brown coat and a finish coat of plaster were applied to the boards. The inner side of the exterior walls and the ceilings were similarly plastered, the gypsum board being attached to metal furring strips.

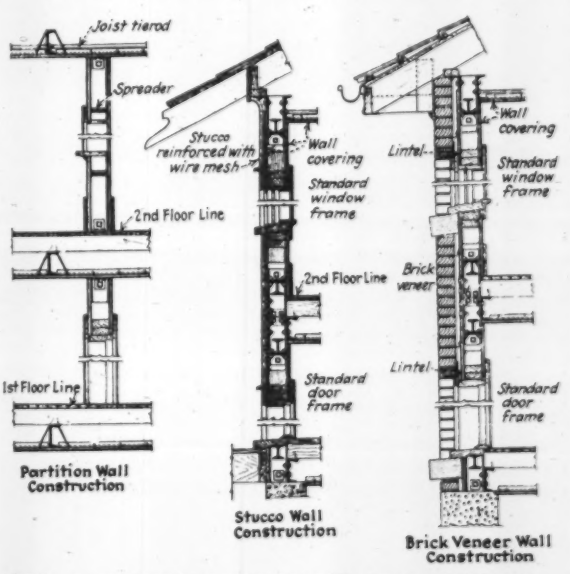


FIG. 9—TYPICAL STEEL HOUSE WALL SECTIONS, COLORADO FUEL & IRON COMPANY

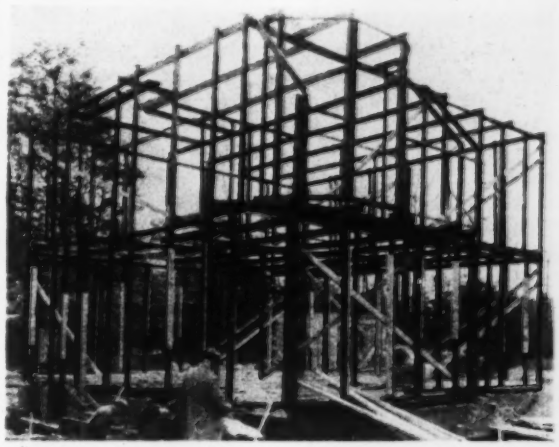


FIG. 10—STEEL-FRAME HOUSE OF THE McKAY FIREPROOF COMPANY

The roof was of the customary materials laid on wood sheathing strips attached to the steel rafters. Wood windowframes were used.

Whereas in the Naugle house the studs and joists were placed 16 in. on centers and the studs had clips, punched from the studs, for fastening the metal lath, in the Jones & Laughlin construction the studs and joists were 24 in. on centers and there were holes punched in the studs for fastening the lath.

In Fig. 7 another steel-frame construction is shown. This one was originated by the Steel Frame House Company, Pittsburgh, Pa. All members except the joists are perforated with holes spaced close together to assist in making connections. Any wall covering can be used for the exterior, and various types of floors are adaptable. The Walter Bates Steel Corporation, Gary, Ind., builds a similar type of steel frame except that the studs have no continuous lines of holes and the bracing is manufactured by shearing a portion of the vertical angles as shown by Fig. 8. Lattice beams are used for the joists and purlins.

The Colorado Fuel & Iron Company is using a design of the McKay Fireproof Company, Cleveland, Ohio (Figs. 9 and 10), in which 4-ft. bays of steel struts, joists and purlins are used. For the floors 2x4-in. wood joists are supported by the steel on 4-ft. centers. Insulation is secured by using $\frac{3}{4}$-in. gypsum boards in the walls.

At Forest Hills, L. I., Robert Tappan erected a steel frame house shown in Fig. 11, using steel supports in the walls and steel joists on 4-ft. centers. Rods were

fastened to the uprights, to which the wire lath was secured. Corrugated sheet steel was used with concrete for the floors.

Mr. Tappan is now arranging to sell material for steel houses that have a frame made up of 3-in. standard beams or channel posts, spaced 4 ft. apart by small steel angles bolted to the top and bottom. The houses are constructed story by story, like a sectional bookcase, according to Mr. Tappan, who describes them further as follows: "All supporting walls are one story high, with the floorbeams fitted between. At the building site the skeleton walls are assembled with a monkey wrench and are then tipped up into place by man power. Lightweight wall, roof, floor and partition units can be manufactured of metal lath, welded to strip steel reinforcing angles. The window units contain steel sash electrically welded in place. The door units have openings to receive steel-trimmed doors. All of the units are locked to the steel framework of the house by pounding over with a hammer the free legs of the reinforcing angles against the adjoining beams or channels."

While some of the above-mentioned houses are far removed from others in detail, they will appear almost identical to the novice who sees the steel structure in its bareness. Briefly, they resemble the conventional wood house with the studs, joists, rafters and lath converted to steel but with the addition that concrete or stucco takes the place of rough flooring or sheathing.

Where Does the Trouble Lie?

A survey of the organizations that have promoted the steel-frame houses shows that most of them have been interested only in selling a certain line of material. They will not contract to build the house, and so it is left to the builder of each job to choose his own materials and put them together as best he can. This is as sensible as having a garage mechanic choose the materials for assembling a new automobile. Granted that the garage man might have the necessary intelligence, he would not have the necessary facilities.

A manufacturer of automobiles will spend hundreds of thousands of dollars a year on improved designs. One motor car company advertises that 25,000 operations are necessary in the production of its car. The solving of engineering problems and the use of mass production has made the present-day automobile possible. More people require homes than automobiles, yet the building of a house has been considered a problem of the mechanic rather than of the engineer. It is patent that residence construction will not be placed on an efficient basis until it is recognized as an engineering problem and is undertaken by a corporation large enough to be able to spend large sums of money on designs and experiments.

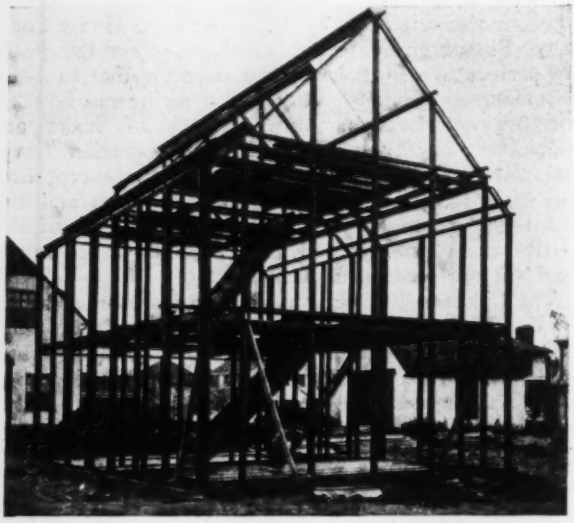


FIG. 11—STEEL HOUSE FRAME AT FOREST HILLS, L. I.

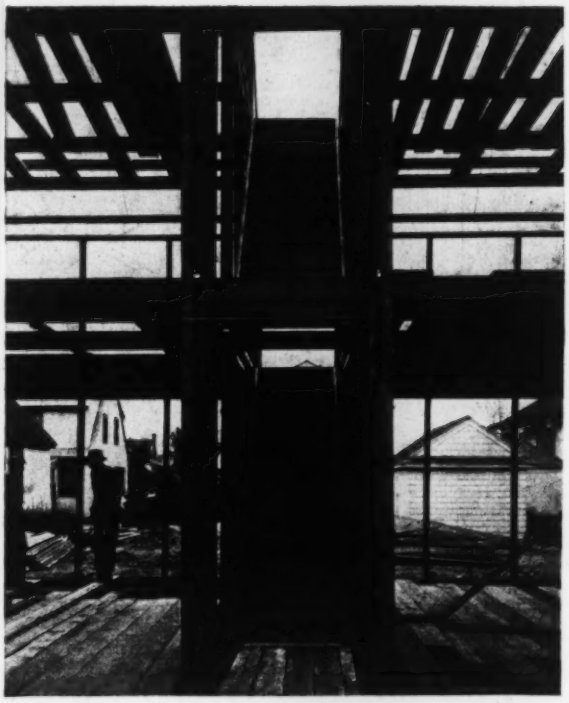


FIG. 12—STEEL STAIRWAY IN FOREST HILLS STEEL HOUSE

Because everything has been left to the individual builder, there is today no standard by which a house may be measured. It is appalling that a construction so vital to the comfort, contentment and economic welfare of 120 million people should not have some standards by which a prospective buyer could measure the strength of the framing, the adequacy of the insulation and the degree of protection afforded from rain, decay and fire. Such standards are as vital to the loan companies as to the buyer. Indeed, if the money lenders used sufficient care, there would be no good loans on bad buildings.

The methods of house building may be out of date, the prospective owners may not have known how to secure a home, building material sales forces may have misused their possibilities, financial institutions may have wanted to help themselves more than the home owner, but the statement of these facts is not the solution of the problem. An analysis of the necessary materials and methods of construction obviously is the next step. This should open the door to a possible solution.

(A second article by Mr. Foster will appear next week)

Survey of Arkansas Government

The Bureau of Municipal Research of New York has been employed to make a survey of the entire governmental structure of the State of Arkansas. The survey is being sponsored by Governor Parnell.

Irrigation Works Construction in Mexico

Don Martin Dam Has Earthfill With Concrete Face and Concrete Spillway With Steel Radial Gates—Earth Dike With Stone Facing Closes Low Points of Reservoir—Main Canal System—American Contractor's Construction Plant and Methods—Labor Conditions

By R. M. Conner and Andrew Weiss
Construction Superintendent and Resident Engineer, The J. G. White Engineering Corporation, New York

TO PROMOTE agricultural development in certain parts of Mexico by means of irrigation, a law was passed in 1926 creating a National Irrigation Commission, and in October of that year the commission authorized the construction of the Nueva Espana project, about 60 miles west of Laredo, on the international border. This project, as described in *Engineering News-Record* of March 21, 1929, p. 453, will have a storage reservoir formed by the Don Martin dam on the Salado River. The dam (Fig. 1) consists of an earth embankment 3,484 ft. long, with a maximum height of 105 ft. and an effective concrete spillway length of 565 ft., which forms an extension of the earth dam and is fitted with regulating gates. There is also an earth dike about 6 miles long and having a maximum height of 32 ft., to close some low-level openings between the hills which surround the reservoir. The present article deals with the construction work on this project.

Construction Camps—Three principal camps of a permanent character were established, the headquarters being near the dam site at Don Martin, one auxiliary camp at Camaron, the nearest railroad and shipping point, 42 miles southeast, and one at San Antonio, 16 miles downstream from Don Martin. These latter camps provide suitable bases for the construction organizations on the canals and drains as well as for the engineering parties which preceded and accompanied them.

Camp quarters, repair shop and storehouses were built, together with a water-supply and filtration system, a sewerage system with septic tank, an electric light plant and an ice plant. A well-equipped machine shop was established at Don Martin for all ordinary repairs to the excavators, trucks, automobiles and other machinery. This shop was especially important because of the scarcity of such facilities within reach and the customs difficulties attending shipments from the United States.

Highway and Haulage—As a decided advantage for motor-truck transport instead of railway transport was disclosed by a study of the situation, the first feature of construction was a gravel road between Camaron and Don Martin. Favorable topography and soil conditions prevailed for most of the distance. This road is also a permanent asset for the project and may be extended northwest some 50 miles to Sabinas and the neighboring coal-mining region. For the construction service there was a fleet of 22 motor trucks of 5-ton capacity. These were supplemented by one 40-ton trailer and four 6-ton trailers for handling such heavy equipment as locomotives, rails and reinforcing steel and for other equipment not easily transportable by the trucks. This service has

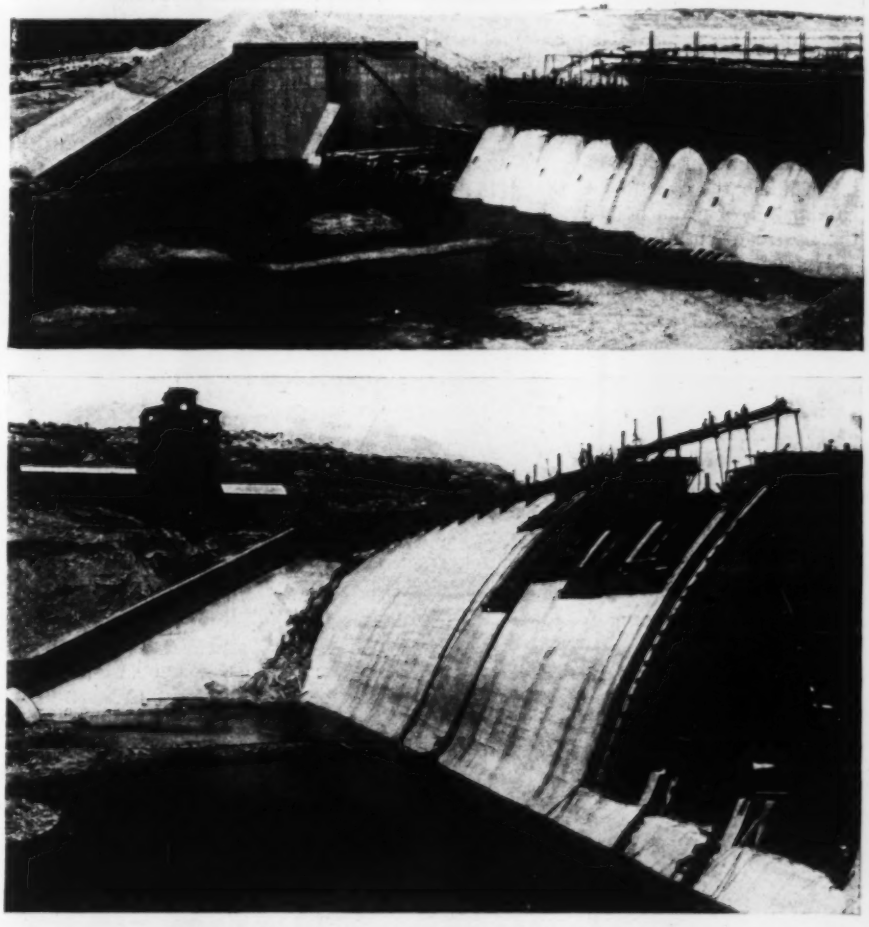


FIG. 1—SPILLWAY OF DON MARTIN DAM, MEXICO
Above—upstream side, with retaining wall at end of earth fill. Below—downstream side, with steel construction trestle concrete plant at left.

been very satisfactory, the cost averaging about 30 centavos (14c. U. S. currency) per ton-mile, including all overhead charges and depreciation of equipment.

Construction of the Earth Dam—During the preliminary work, prospecting was carried on to select the most suitable site for securing material for the earthfill. This study included a number of open pits in the area investigated and resulted in selecting a site of 50 acres about 1.3 miles from the dam. The material is a mixture of earth and gravel.

A topographic survey of the site of the dam was made in order to take advantage of favorable features and thus secure minimum cost. The geology was also studied superficially and by means of test borings. These investigations disclosed an anticlinal formation of hard limestone intercalated with hard shales but well compacted. The dam is placed on the upstream slope of this anticline and almost parallel with its axis, except at the river crossing, where the overflow section makes an angle of about 45 deg. with the axis of the anticline. To secure a tight connection, the foundation excavation and stripping of the spillway are carried well into the limestone at the south abutment, while on the opposite or north end, this connection was established by means of a deep trench penetrating the alternating beds of rock and clay and filled with the upstream concrete cutoff wall, which connects with the upstream facing of reinforced concrete.

The site was stripped of vegetable matter and roots, as is usual in the construction of earth dams. The overflow or concrete section was well connected with the underlying limestone to insure a minimum infiltration with its attendent dangers. This precaution was supplemented by grouting at 90-lb. pressure through 30-ft. holes spaced 10 ft. center to center along the axis of the upstream cut off wall. However, the tightness of these beds was such that little more than the capacity of the grout holes was taken under the overflow section and south abutment. A similar line of grout holes was extended along and under the upstream cutoff wall.

Haulage of material for the embankment was effected by seven to eight trains drawn by 20-ton oil-burning locomotives, each train consisting of from twelve to fourteen dump cars of 5-yd. capacity (Fig. 2), which were loaded by two 2½-yd. steam shovels. Following each unloading the tracks were shifted by 30-hp. tractors (Fig. 2) a sufficient distance to permit the spreading of the material, after suitable sprinkling, in 8-in. layers. This spreading was done by two 60-hp. crawler tractors with graders, followed by four 12-ton road rollers. The material was of ideal composition, containing a sufficient amount of fines to form a very compact mass and weighing in the compacted state about 135 lb. per cubic foot. This embankment was commenced about March, 1927, and was practically completed in January, 1929.

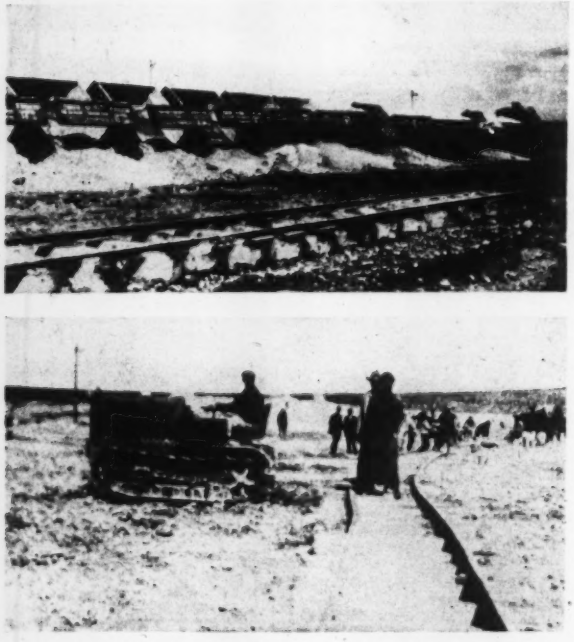


FIG. 2—BUILDING THE EARTH DAM
Above—train of dump cars delivering material. Below—tractor shifting dump-car track.

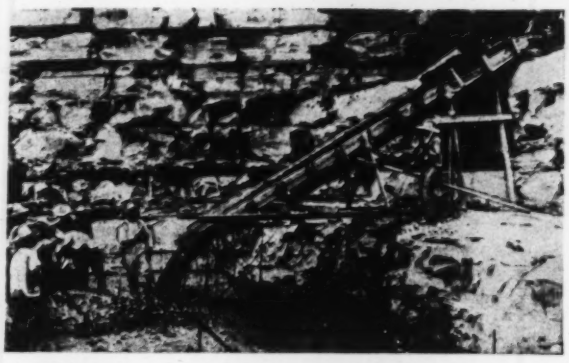


FIG. 3—CONCRETING BASE OF SPILLWAY

Concrete Work—Erection of the retaining wall forming the south abutment was carried on simultaneously with the embankment as far as practicable and so as to afford a minimum of interference. Aggregates for the concrete were obtained by crushing the limestone obtained near the north abutment, the sand being obtained by passing part of the crushed material through a pulverizer. This crushing plant was of the portable type, with a capacity of 120 tons per eight-hour shift.

While this work was in progress a crushing and concrete-mixing plant was being completed on the south side of the river, where the overflow section joins the hill forming the south abutment. Concreting the foundation for one of the spillway piers is shown in Fig. 3. Most of the concrete material was obtained from this part of the excavation, which is intended to form a spillway extension having four additional radial gates 25 ft. long and 14½ ft. high, or the same size as the 22 automatic gates on the main part of the overflow section. Rock from the spillway excavation, after suitable selection, is passed to a gyratory crusher driven by a 240-hp. diesel engine of the marine type, which also drives the screens, sand mill, mixers and auxiliaries. Crushed stone is elevated 70 ft. to a revolving screen, from which it passes into the storage bins used for supplying the mixer plant below and for loading the trucks which convey aggregate to other parts of the work. Part of the crushed material is returned to a 36-in. cone crusher which furnishes the sand or fine aggregate. No natural sands or gravels suitable for concrete are available in this locality. Immediately below the storage bins are the two 1-yd. mixers, from which the concrete is conveyed to the forms by side-dump cars.

Concrete for the outlet works and retaining wall was made by four ½-yd. mixers and was delivered in place by side-dump cars, hand buggies and gravity chutes, as in the case of the overflow section.

Concrete Revetment—A reinforced-concrete slab protecting the upstream face of the earth dam is 11 in. thick

at its connection with the upstream cutoff wall and 8 in. where it joins the parapet wall. For this revetment there is a ½-yd. mixer and the concrete is hauled in side-dump cars drawn by a 14-hp. gasoline locomotive. The facing is being laid as a monolith, with continuous reinforcement composed of ¾-in. corrugated bars spaced 12 in. center to center in both directions. It is poured in alternate vertical strips 10 ft. wide, as shown in Fig. 4.

Auxiliary Dike—A series of connected saddles with openings extending below the flow line of the reservoir necessitated the building of a dike nearly 6 miles in length, with a maximum height of about 30 ft., involving

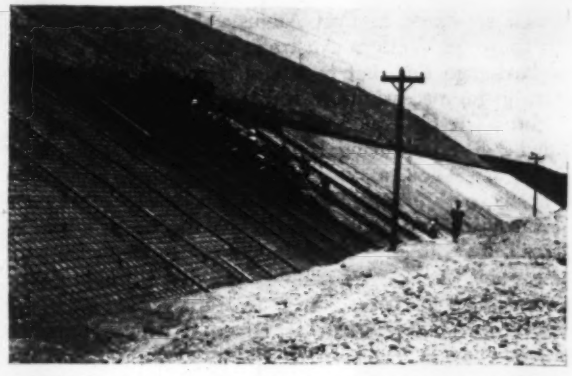


FIG. 4—PLACING CONCRETE FACE ON MAIN DAM

902,800 cu.yd. of earthwork and 39,000 cu.yd. of stone masonry facing laid in lime mortar (Fig. 5). The earthwork was begun near the end of December, 1927, and was finished in March, 1929. On account of the relative scarcity of suitable material, the borrowpit area spread over a wide strip of ground downstream from the axis of the dike. The major part of the material was loaded with three elevating graders, each served by eight to twelve dump wagons of 1½-yd. capacity, according to length of haul, which ranged from 180 to 600 ft. This plant was supplemented by a number of slip scrapers and mule teams, thus affording employment for native labor and at the same time advancing the rate of progress. The material was spread by means of graders with 30-hp. tractors, levelled in 8-in. layers, wetted and then rolled with 12-ton road rollers.

Excavation—For its first 18 miles the main canal maintains a uniform section with 60-ft. bottom width; depth, 13.3 ft.; water depth, 10.6 ft.; crown width of embankment, 16.7 to 19.7 ft. It has a grade of 0.01 per cent; a computed velocity of 2.78 ft. per second and a capacity of 2,239 sec.-ft. Excavation (Fig. 6) began in March, 1927, and with its extension into the principal laterals and drainage systems has proceeded without interruption. The major equipment consists of eighteen diesel dragline excavators with 1½-yd. buckets. Some of the deeper and heavier cutting was effected by a 2½-yd. diesel-electric dragline.

Many of the cuts were of larger dimensions than suitable for the machines used, but as these machines are the property of the Irrigation Commission and as the commision desired to keep its equipment mainly in such sizes as would be most useful in the great percentage of its future operations, it was decided to use only machines of moderate sizes offering the best prospective utility. A large part of the main canal passed through uncommonly difficult material, varying from mixtures of crystallized gypsum embedded in very compact clays to hard conglomerate rock. It was therefore necessary to use large quantities of explosives, and the drills were served by a battery of four to six portable gasoline air compressors.

Distribution System—In realization of the difficulties encountered in colonization work, the commission decided to extend its distribution system only to cover the first irrigation unit, together with such laterals and drains as would be needed in that part of the development. This first irrigation unit is planned to cover some 40,000 acres in the vicinity of Camaron and Rodriguez, both on the main line of the National Railways of Mexico between Laredo and Mexico City. All distributaries to individual farm units, as well as the principal drains, are excavated and require only to be supplemented by additional lateral drains, as future necessities may require. To this must be added such structures as flumes, siphons, drops, culverts, turnouts and checks, which are a necessary part of such a system. These latter were for a time held in suspense, pending the completion of the storage system and in conformity with the available funds.

Road System—A complete system of market roads and feeders is being built to give suitable outlets to all farm units. At present, the building of roads has been confined to those necessary for the transport of materials from Camaron to Don Martin and to the dike and from

FIG. 5—BUILDING STONE REVETMENT ON DIKE

Camaron to Rodriguez, as well as about 25 miles of secondary roads.

Costs—The unit as well as the total costs of all features are generally well within the estimates.

Design and Construction—In 1926 the Mexican government contracted with the J. G. White Engineering Corporation, New York, for the investigation, design and construction of several irrigation projects, under the direction of the National Commission of Irrigation. All the engineering and construction work on the Nueva Espana project has been carried out under this contract and in conformity with the policies and general directions of the commission.

In compliance with the policies of the commission, the legal requirements as to the percentage of Mexican labor, both skilled and unskilled, has been complied with throughout. It was necessary at the outset of the work to build an adequate working organization around a nucleus of specially skilled and trained men from the United States, such as general foremen on construction and operators of dragline and power-shovel excavators, but local or native talent has been and is being trained as

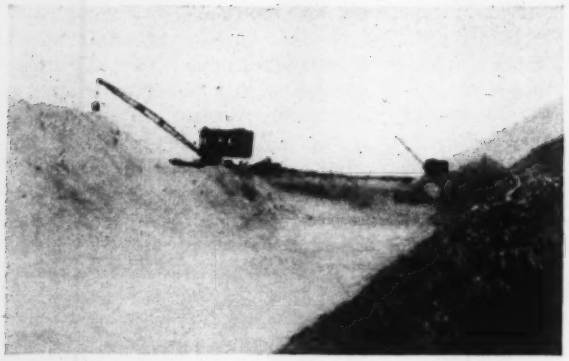


FIG. 6—EXCAVATING THE MAIN CANAL

rapidly as circumstances permit. The total force employed has ranged from a maximum of 3,000 men to a minimum of about 1,600, according to the finances available and the status of the work. While during the earlier part of the operations the number of skilled men from the United States amounted to about a dozen experienced construction general foremen, including the master mechanic, and some 40 skilled dragline and shovel operators, these numbers have been gradually reduced by replacement of native talent, especially in the latter classes, so that during the past several months the number of Americans employed is less than 1½ per cent of the total organization. The project engineering force consists at present of three Americans, including the resident engineer, and some 25 Mexican engineers ranging in grades from instrument men to those employed on design and construction, according to experience and training.

G. W. Caldwell is general manager for the J. G. White Engineering Corporation; F. E. Weymouth was its chief engineer until March 1, 1929, when he was succeeded by C. H. Howell. H. V. R. Thorne is construction supervisor; R. M. Conner is superintendent of construction, A. Becerril Colin assistant superintendent and Andrew Weiss resident engineer. The commission is locally well represented by one of its consulting engineers, Manuel Bancalari; its administrative supervisor, Francisco Ballesteros, and Trinidad G. de la Cadena, inspector of machinery.

Sewage Trickling Filters for Bradford, England

The first half of a 60-acre trickling sewage filter project for Bradford, England, was completed with a six-acre installation officially opened on Oct. 2, 1929. The beds cover from three to eleven acres each and are "terraced out in sections on the hillside," according to a brief article in the London *Surveyor* of Oct. 11, 1929. The beds have concrete walls and bottoms, are filled to a depth of 6 ft. with 1- to ½-in. coal and cost £17,000 ($83,000) an acre, complete, of which £9,687 ($4,700) is for the traveling distribution troughs, driven by sewage-fed waterwheels. Sewage from the troughs falls through nozzles onto spray plates. The "distributors are balanced in all weathers by 5 1/16-in. steel ropes, which are used also for haulage purposes, passing round an arrangement of grooved drums and pulley wheels." The distributors (receiving clarified sewage?) are rated at from 70 to 190 Imp. gal. per acre per 24 hours (about 0.385 to 1.085 U.S. m.g.d.). H. Wonter-Smith is sewage engineer of Bradford. The contractors for the distributing apparatus were Hartley, Sons & Company, Stoke-on-Trent, England. The population of Bradford is estimated as nearly 300,000.

Australian Federal Railways

FOUR railways owned and operated by the commonwealth (or federal) government of Australia independent of those of the several states, comprise portions of two transcontinental lines and include a 5-mile standard-gage branch serving the federal district of Canberra (which corresponds to our District of Columbia). According to the annual report of June 30, 1929, these lines total 1,970 miles.

The Trans-Australian Railway is an east and west line extending 1,052 miles across desert country on the south side of the continent to connect the railways of the eastern states, at Port Augusta, in South Australia, with those of Western Australia at Kalgoorlie. It is a standard-gage line, but each end connects with lines of 3½-ft. gage, necessitating transfer of passengers and freight. The Central Australia Railway, which was extended 293 miles during 1928 and 1929, now runs north from Port Augusta, in Victoria, to Stuart, in Central Australia, 648 miles. The North Australia Railway extends south from Port Darwin, on the north coast, to Birdum, 265 miles. Between these two lines, both of 3½-ft. gage, is a gap of about 600 miles, through desert and unsettled country. At some future time they will be united to form a north and south transcontinental railway.

Water Supply and Treatment—With so much dry and desert country the water supply is a problem, which was accentuated in 1928 and 1929 by severe drought and light rainfall, so that the railway reservoirs were empty. Water obtained from drilled wells is of very bad quality for boiler supply and its use increases the expenses for locomotive repairs. However, the Trans-Australian line has now two plants which treat this water by the barium-carbonate process to reduce the scaling and corrosion in the boilers.

Drifting Sand—There has been considerable trouble with drifting sand on the Central Australia line, increased by the drought. Sometimes cuts were filled with 9 in. to 8 ft. of sand, while high winds would fill the cuts soon after they were cleared for the passage of trains. Experiments to stop this drifting of the sand have been unsuccessful.

General Conditions—Considerable increase in maintenance and renewals is to be expected, as many parts of the lines are of light construction, while traffic and loads on the main lines are increasing. On the other hand, some of the extensions have such light traffic, in some cases train service every two weeks, that the receipts will not pay operating and maintenance expenses. Unification of gage is still a serious but unsettled problem, although it has been decided that the railway systems of 3 ft. 6 in. and 5 ft. 3 in. gage must be converted eventually to standard gage. In April and June, 1929, conferences were held by the engineers and railway commissioners, after which a revised estimate of cost was submitted to the federal and state governments. A standard-gage extension of the New South Wales railways is being built across the Queensland border to Brisbane, the capital city, to avoid change of gage to the 3½-ft. railways of Queensland. This will be completed next summer. New and more powerful locomotives will soon be required for the federal railways, as those in service are old and have had heavy usage in regular traffic and on construction work.

Acoustic Correction of Auditoriums

Increasing Consideration Given to This New Science Has Led to Its Development to a Point Where the Acoustics of a Room Can Be Prescribed With Certainty of Success

By F. R. Watson
Department of Physics, University of Illinois

WITHIN the past few years an increasing amount of attention has been paid to the acoustic adjustment of rooms. Increased knowledge of the subject, many publications, activities of commercial companies, and particularly the introduction of the radio and talking movies, have all been instrumental in causing architects and owners of buildings to give consideration to this new science. Theory and practice have developed to such an extent that the acoustics of a room can now be prescribed with certainty of success, as illustrated by a large number of rooms that have been properly treated. In spite of this development, it is interesting to note that a number of incorrect popular ideas of acoustic correction still prevail.

For example, many people think that wires will help the acoustics; but this device is practically useless. In one case as much as 5 miles of wire was installed without benefit. Sounding boards are also supposed to be of value, but they prove to be insufficient as a corrective, although they are very useful when properly designed and placed on a stage to help a speaker. Another feature that is considered important in the control of acoustics is the shape of a room. Experience, however, shows that the shape is usually of small consequence, unless curved walls are present which may produce very annoying echoes. Electric amplifiers give greater volume to a speaker's voice, but they will not correct defective acoustics.

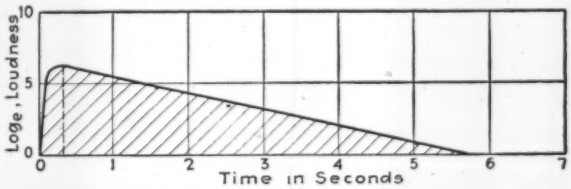


FIG. 1—PLOT OF LOUDNESS OF SOUND IN A ROOM

The chief acoustic trouble in an auditorium is a reverberation, or excessive prolongation of sound, due usually to the small absorbing value of the plaster surfaces, concrete or wooden floors and glass windows. In such a room, the words of a speech overlap and produce a confusion that makes it difficult for an auditor to understand. The effective method of correcting a reverberation is to install sound-absorbing material of some kind, such as carpets, heavy curtains, upholstered seats, and also special lining materials as hairfelt, flax quilts, fiberboards, acoustic plasters and others, so as to cause sound to die out more rapidly.

Action of Sound in a Room

Fig. 1 gives a diagram of the sound of a word uttered in a reverberant room. The loudness builds up quickly as the word is spoken, after which it dies out more gradually, something like a skyrocket that rises rapidly and releases a parachute that drops uniformly and more slowly. The loudness of four words of a speech in a reverberant room is plotted in Fig. 2. Before the first one dies out several others are uttered which overlap with the first, as shown in Fig. 2 at *ab*, for instance, so that auditors are unable to distinguish the separate words and find it difficult to understand the speaker. Fig. 3 pictures the same room after it has been corrected with absorbing materials. Sounds die out more quickly than before and each word stands out more distinctly, with less overlap and interference from other words, with the result that auditors can understand more easily and with less effort.

The reflection of sound and the resulting reverberations thus play an important part in the acoustics of rooms, and in fact is responsible for the defects that occur. For this reason it appears desirable to eliminate all reflected sound from the auditors. However, a certain amount of reflection about the speaker or musician is desirable, since it increases the loudness somewhat and allows performers to "hear themselves" so that they can adjust their voices to give the best effect, but the reflecting walls must not be farther than about 28 ft. from the speaker if distortion of speech is to be avoided.

An ideal auditorium, as outlined by the author in "Ideal Auditorium Acoustics," *Jour.* Am. Inst. Archts., July, 1928, would be one in which carefully adjusted reflecting walls are placed about the performer, while the rest of the auditorium is made as dead as possible by absorbing materials. Some years ago it would not have been considered good practice to install so much material in a room, particularly because musicians complained that the acoustics were made too dead; but if the stage walls are properly designed and not deadened too much, the complaints disappear. Many properly designed rooms support the truth of this theory.

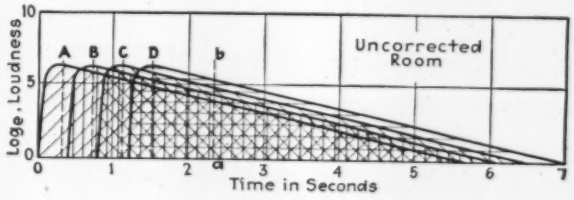


FIG. 2—PLOT SHOWING OVERLAP OF WORDS OF SPEECH IN A REVERBERANT ROOM

Echoes and Other Acoustical Defects—Thus the chief acoustical defect in a room, reverberation or prolongation of a sound, may be corrected by installation of a calculated amount of sound-absorbing material. But there are other possible defects. An auditorium with curved walls, for example, is quite certain to have concentrations of sound, sometimes producing marked echoes. Two procedures are considered in such cases. One is to change the shape of the wall so as to avoid the concentration of sound, or to install grillwork that lets the sound through without reflection. The second

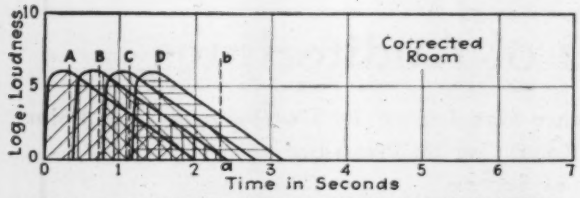


FIG. 3—THE SAME ROOM PICTURED IN FIG. 2 AFTER IT HAS BEEN CORRECTED WITH SOUND-ABSORBING MATERIALS

method is to install coffering or absorbing material in special patterns to break up the reflected sound. Other acoustic defects sometimes appear. Alcoves and spaces under balconies will resonate to certain sounds and produce an annoying re-enforcement. The application of absorbing material usually reduces this disturbance. Occasionally, with organ music or similarly prolonged tones, an interference between direct and reflected sounds is set up; but this is infrequent and is not so vital a consideration as the reverberation. While it is true that a reduction in the reverberation is the usual method of correcting the acoustics of rooms, the occasional defects of echoes, resonance and interference must be looked for in each auditorium if embarrassing situations are to be anticipated.

An important question arises as to the amount of sound-absorbing material needed to quiet a room efficiently, the answer to which is given by calculation. A reverberation equation was developed by Prof. Wallace Sabine: $t = 0.05\,V/a$, where t is the time taken for a sound to become inaudible, the number 0.05 represents the loudness of a standard sound, which is 1,000,000 times as intense as a sound barely audible, V is the volume of the room in cubic feet, and a gives the absorption of the walls, ceiling, floor and all other articles in the room exposed to the sound.

To secure good acoustics it is necessary to determine how much the time of reverberation should be reduced. After a study of a large number of rooms, a plot was made as shown in Fig. 4, which gives the critical time for good acoustics for any auditorium, whatever the volume. It is to be noted that this time is short in any case, hardly exceeding two seconds even for a large room of 1,000,000 cu.ft., while small rooms may have as short a time as 0.85 second or less.

For practical correction of rooms, the values given in Fig. 5 are useful. That is, to secure the critical times pictured in Fig. 4, absorbing material must be installed in amounts shown in Fig. 5. For example, in a room of 460,000 cu.ft. the amount of material needed with one-third audience present is 9,000 units. Suppose that the

TABLE I—SOUND-ABSORBING COEFFICIENTS FOR PITCH 512
(Copied largely from Table VI, Watson's "Acoustics of Buildings")

Material	Coefficient Per Sq.Ft.
Open window	1.00
Acoustex	0.37
Akoustolith (artificial stone)	0.36
Ambler sound-absorbing plaster	0.14
Balsam wool, bare, 1 in. thick, 0.26 lb. per sq.ft.	0.44
Brick wall	0.032
Brick wall, painted	0.017
Brick, set in cement	0.025
Cabot's quilt, two layers of triple ply, with decorative membrane	0.51
Calacoustic Plaster	0.19
Carpet, unlined	0.15
Carpet, lined	0.20
Carpet, with ¼ in. Ozite hairfelt	0.25
Carpet rugs	0.20
Celotex, unperforated, 71–16 in. thick	0.20
Acousti-Celotex, type A, unpainted	0.25
Acousti-Celotex, type B, painted or unpainted	0.47
Acousti-Celotex, type BB, painted or unpainted	0.70
Acousti-Celotex, type C, painted or unpainted	0.30
Corkoustic, 1 in. thick, 0.875 lb. per sq.ft.	0.30
Corkoustic, sprayed with cold water paint	0.30
Corkoustic, 2 in. thick, 1.6 lb. per sq.ft.	0.35
Cork tile	0.03
Curtains in heavy folds	0.40–0.75
Fibroblock, unpainted, 1½ in. thick	0.42
Flaxlinum, bare, 1 in. thick	0.61
Flaxlinum, 1 in. thick, with unpainted membrane	0.61
Flaxlinum, Acoustic Tile, ½ in. thick, with wooden casing and metal screen	0.42
Flaxlinum Acustic Tile, 1 in. thick, with wooden casing and metal screen	0.54
Gimco Rock Wool, bare, 1½ in. thick, 1.44 lb. per sq.ft.	0.57
Glass (single thickness)	0.027
Hairfelt, bare, 1 in. thick, 0.75 lb. per sq.ft.	0.58
Linoleum	0.03
Marble	0.01
Nashkote A, ½ in. thick	0.31
Nashkote A, ¾ in. thick	0.41
Nashkote B, ½ in. thick	0.37
Plaster on wood lath	0.034
Plaster on metal lath	0.033
Plaster on tile	0.025
Sabinite Acoustical Plaster	0.21
Stage opening, depending on stage furnishings	0.25–0.40
Ventilators	0.75
Wood, plain	0.06
Wood, varnished	03
Acoustic Zenitherm (cork granules cemented with plaster 1.14 in. thick, 2.07 lb. per sq.ft.)	0.33
U.S.G. Acoustical Tile, ½ in. thick	0.56
Individual Objects	**Coefficient Per Sq.Ft.**
Adult person	4.7
Plain wood seats	0.15
Church pews, per seat	0.2–0.5
Seat cushions, per seat	1.00–2.00
Opera chairs (see details in separate report)	
(a) Plywood seat and back, no upholstery	0.24
(b) Padded seat and back, covered with Pantasote (imitation leather)	1.6
(c) Various paddings, covered with velour or mohair	2.3–3.5

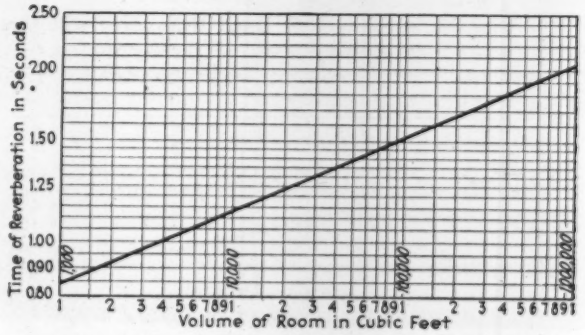


FIG. 4—PLOT SHOWING THE CRITICAL TIMES OF REVERBERATION FOR ROOMS OF DIFFERENT VOLUME, BY WHICH GOOD ACOUSTICS MAY BE OBTAINED

absorption of the walls, floor, ceiling and seats is 2,144 units, while one-third audience, 670 people, adds 3,082 units, giving a total of 5,226. It is then necessary to add 3,774 units to the room to secure the total of 9,000 units for good acoustics. The 3,774 units may be added in several ways: (1) 7,548 sq.ft. hairfelt, 0.5 per sq.ft.; (2) 1,348 velour or mohair upholstered seats, 2.8 per seat; (3) 1,348 pantasote seats, 1.3, or 1,750 units, plus 4,048 sq.ft. hairfelt, 0.5, 2,024 units.

Materials Available for Acoustic Correction—The numerical example just given shows that an acoustic correction of a room is made by deadening it with one or more sound-absorbing materials so that average sounds will die out in one or two seconds of time. In making a correction, it becomes necessary to choose among materials to suit the requirements of the room. Table I gives a list of available materials from which a choice may be made. For example, hairfelt 1 in. thick has a coefficient of 0.58 for the pitch 512, which means that 58 per cent of the incident sound is absorbed and 42 per cent is reflected. Accordingly, at this pitch 500 sq.ft. of hairfelt would furnish 290 "units." The same number of units would be given by approximately 1,930 sq.ft. of unlined carpet of coefficient 0.15 (1,930 × 0.15 = 290) or by 97 upholstered seats of coefficient 3.0 (97 × 3 = 291). According to this conception of absorp-

tion, an open window 1 sq.ft. in area is sometimes taken as a standard, assuming that it reflects no sound at all but that it absorbs (really transmits) 100 per cent, so that its coefficient is taken as 1. Absorbents such as seats and people, which cannot conveniently be reckoned in square feet, have absorbing values given per object. In making calculations for the correction of rooms, only the coefficients for the pitch 512 are used, since this gives a fair average of the values for all the pitches.

Materials that are completed in the factory and shipped for installation are more likely to have laboratory coefficients than products that are constructed on the job, where the skill of the workman determines the efficiency. Painting or decorating a material is quite sure to affect the absorption if the pores of the material are closed. Membranes can be used to cover materials provided they are porous so that sound has easy passage to absorbent underneath. Painted membranes are also used, but the process of painting must leave the membrane flexible so that it can transmit the sound energy to the material underneath.

Recent Tests of Absorbing Materials—Among the new coefficients listed in Table I are those for opera chairs, Flaxlinum with a metal screen cover, and U.S.G. Acoustical Tile, the values for which were recently determined by the writer. Sabine's reverberation method was used, but with some improvements in the procedure. (See details of earlier tests in Bulletin 172, University of Illinois Engineering Experiment Station, "The Absorption of Sound by Materials.") The Flaxlinum, either ½

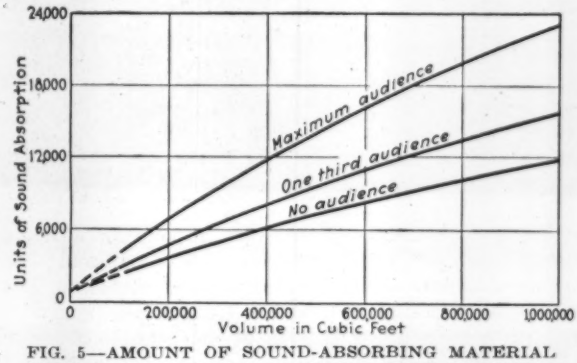


FIG. 5—AMOUNT OF SOUND-ABSORBING MATERIAL NEEDED IN ANY ROOM TO INSURE GOOD ACOUSTICS

or 1 in. thick was mounted in a wooden frame 16x16 in. that could be installed on a wall or ceiling for the purpose of deadening sound. A metal screen for decorative effect was placed over the face of the frame, with an air space between it and the Flaxlinum underneath. The acoustical tile manufactured by the United States Gypsum Company is made of pressed rock wool and forms a porous material that looks well and has an efficient absorption for sound. The chairs tested were special types manufactured by the American Seating Company, for which the average absorbing values ranged from 0.3 to 3.6 depending on the particular arrangement of materials and cushions. Results are given in Table II.

Coefficients of Absorption of Opera Chairs—In view of the dearth of information about the absorbing values of modern upholstered chairs, the results obtained are given in some detail in Table III. For clearness in describing the data, the following terms are used—a "chair" has a "back" and a "seat."

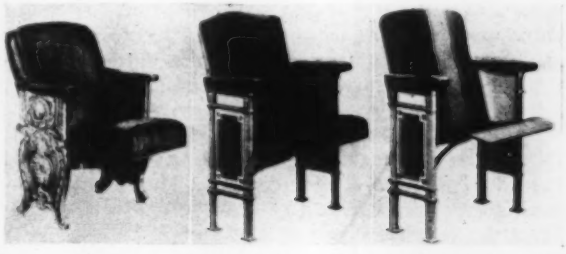
Discussion of Results—The tests on the upholstered chairs allow the following conclusions to be drawn:

1. Depending on the particular kind of cushion and

(a) Spring edge velour seat, padded back with velour on front and plywood on rear. Average coefficient, 3.3. See test 1*a*.

(b) Same as *(a)*, but with panel velour back. Average coefficient, 2.6. Test 1*c*.

(c) Same as *(a)*, but with steel on rear of back. Average coefficient, 2.8. Test 1*d*.



(d) Same as *(a)*, but with mohair covered seat and special back. Average coefficient, 3.6. Test 2*e*.

(e) Padded seat and back, covered with imitation leather. Average coefficient, 1.3. Test 3*a*.

(f) No upholstery. Plywood seat and back. Average coefficient, 0.30. Test 4.

FIG. 6—TYPES OF OPERA CHAIRS

covering, the absorption of chairs increases with the addition of upholstery, as shown by the following average coefficients: Plain plywood seat and back (Fig. 6*f*), 0.30; pantasote seat and back (Fig. 6*e*), 1.3; velour seat and back (Fig. 6*a*), 2.9; mohair seat and special back, (Fig. 6*d*), 3.6. Any changes in the chairs, such as the types of back or seat, or differences in the kind of springs or cushions made a variation in the absorption coefficient,

TABLE II—COEFFICIENTS OF ABSORPTION

Material	Pitch	256	512	1,024	2,048
Flaxlinum, 1 in. thick, in wooden casing, covered with metal screen		0.24	0.54	0.60	0.61
Flaxlinum, ½ in. thick, in wooden casing, covered with metal screen		0.18	0.42	0.59	0.48
U.S.G. Acoustical Tile, 1 in. thick		0.35	0.65	0.62	0.68
U.S.G. Acoustical Tile, ½ in. thick		0.28	0.56	0.67	0.57

Note: Of the tile, only the ½ in. is available commercially. The values for the ½ in. thickness were determined by Dr. Paul E. Sabine.

TABLE III—COEFFICIENTS OF ABSORPTION OF OPERA CHAIRS

Type of Chair	Pitch = 256	512	1,024	2,048	Average
	Coefficient of Absorption				
Spring edge velour seat used throughout this test					
(1a) With padded back, covered on the front with velour, with plywood on the rear. See Fig. 6a. (Seats turned down)	3.1	3.1	3.4	3.7	3.3
(1b) Same as 1a, seats turned up	2.7	2.7	3.0	3.1	2.9
(1c) Same as 1a, but with panel velour back. Fig. 6b. Seats turned up	2.3	2.3	2.8	3.0	2.6
(1d) Same as 1a, but with steel velour back, seats up. Fig. 6c	2.6	2.8	2.9	2.9	2.8
Spring edge mohair seat used throughout test					
(2a) Same as test 1a, with mohair replacing velour, seats down	3.1	3.0	3.3	3.5	3.2
(2b) Same as 2a, seats up	2.8	2.8	3.0	3.2	2.95
(2c) Same as 1c, mohair replacing velour, seats up	2.9	2.9	3.0	3.0	2.95
(2d) Same as 2a, with mohair covering the plywood rear, seats up	3.2	3.0	3.0	3.4	3.15
(2e) Same as 2a, but with the special back shown in Fig. 6d	3.3	3.5	3.7	3.8	3.6
Box spring, pantasote seat throughout test					
(3a) Padded back covered on front with pantasote, with plywood on rear, seats up. See Fig. 6e	1.4	1.6	1.3	0.71	1.3
(3b) Same as 3a, but with the panel back of 1c, seats up	1.7	1.6	1.7	2.1	1.8
(4) Plywood seat and back, no upholstery, seats up. Fig 6f	0.19	0.24	0.39	0.38	0.30

so that the coefficients tabulated apply exactly only to the seats actually tested.

2. The absorption varies with the type of back used.

3. The absorption varies with the type of seat used; the velour seat makes the chair about 50 per cent more absorbent than the pantasote.

4. The absorption is greater with the seats down than with them up, because of the greater surface exposed to the sound. However, in theaters it is when seats are unoccupied that they are useful for absorption. For this reason the coefficients in these tests were nearly all determined with the seats turned up to give information for the actual conditions of use. The increase in absorption with the seats turned down is about 15 per cent.

5. The absorbing value of the velour and mohair chairs is practically uniform over the range of pitches tested. This is an advantage, since they absorb the components of a complex sound uniformly, producing little change in its quality. Many materials absorb sound unequally at different pitches.

6. Taking three rows of chairs 34 in. apart (8.5 ft. total width), each row being 10 ft. long, we get the area occupied by the chairs to be 85 sq.ft. The absorption of the eighteen chairs in this area is $18 \times 2.9 = 52.2$ units, so that the coefficient per square foot is $52.2 \div 85 = 0.61$. This area of chairs would thus have the same absorption as an equal area of bare Flaxlinum 1 in. thick of coefficent 0.61. (See Table I.)

Summary and Conclusions

The discussion in the early part of the paper showed that the acoustic faults in a room are due almost entirely to the reflection of sound from the boundaries. The chief fault is reverberation, or excessive prolongation of sound, whereby succeeding words in speech overlap and produce confusion for auditors. The correction for reverberation lies in the introduction of absorbing materials in calculated amounts, thus assuring good acoustics for a room. Sometimes echoes are present with curved walls and these require special treatment.

A considerable number of commercial products are now available for the purpose of acoustic correction. These vary from soft materials like hairfelt to semi-hard fiberboards and acoustical plaster and tile. Chairs are always present in a room, and thus present a possibility in securing good acoustics if proper types are selected.

No discussion is given in this paper concerning the effect on the acoustics of rooms of the sound transmitted into it or out of it into other rooms. The control of sound transmission is the second important problem in the acoustics of buildings, and its solution involves the properties of wall construction, but it does not introduce any new considerations that change the methods described for the control of reverberation.

Concrete Freight-Train Caboose

A concrete freight-train caboose, with body of reinforced concrete, has been designed by H. N. Gresley, chief mechanical engineer of the London & Northeastern Railway, England, and has been built at the company's shops. A standard steel underframe is used, mounted on four wheels. To this the body is secured by bolts, and its weight obviates the use of the usual cast-iron weights which are necessary for stability in cars having wooden bodies. The railway initials are molded in the concrete, which is painted in the company's standard colors.

Revisions Needed in Gunite Specifications

By John V. Schaefer

President, Cement-Gun Construction Company, New York, N. Y.

Almost from the introduction of gunite or cement mortar protection into the construction field, the standard specifications for this work have called for three parts of sand and one part of cement. Theoretically this is the most ideal mixture, as sand suitable for cement gun work contains approximately 33⅓ per cent voids. But several years of practical experience and the gathering of data relative to cement gun practice has shown this proportioning is correct in theory only.

Consider the typical specification as used by the New York and New Jersey Bridge and Tunnel Commission for the duct walls in the ventilation building of the Holland tunnel. This specification reads that the mixture should be one of portland cement to three parts sand, to be mixed dry before placing in the guns. By "dry" is meant that the sand may contain a normal bank content of 4 to 8 per cent of moisture. But this sand, with its 6 per cent average moisture, has a bulk about 33 per cent greater than that of perfectly dry sand. Because of this bulking the actual amount of sand is really $3 \div 1.33$, or 2.25 cu.ft.

As this material is shot through the gun at high velocity against a hard surface, part of the sand, known as "rebound," bounces off, leaving the cement paste on the surface. The amount of rebound varies with circumstances, but it is not less than 25 per cent, practically all sand. Considering the rebound, the 2.25 cu.ft. of sand is reduced to 75 per cent of this amount as actually sticking in the mortar protection, reducing the sand content to 1.68 cu.ft. Therefore the final proportion of the product becomes 1.68 to 1 instead of the theoretical 3 to 1, which is undesirable.

The practical limits of moisture in sand suitable for cement gun work varies between 2 and 8 per cent; less than this amount causes dusting in the operation, and more than this limit causes the gun to clog up. But because of the varying bulking of sand due to moisture content, the engineer should not set any specific limit as to the amount of moisture the sand should contain.

It is therefore suggested that engineers in writing specifications for cement gun work should take bulking into account and insist that the work be done by an experienced contractor, and then give him a degree of flexibility so that he may vary the sand proportions in order that in the end the cement mortar protection will approach a uniform 3 to 1 mix in place and not on the mixing board. With this in mind the following specifications would be desirable:

> Material for the cement mortar protection shall consist of an approved brand of portland cement, mixed with clean sharp sand in a proportion that will be as nearly practical 1 of cement and 3 of dry sand. The proportion of sand shall be varied from time to time as the bulk of sand exceeds the bulk of dry sand due to moisture content. Sand and cement shall be thoroughly mixed dry and screened through a ½-in. mesh screen before being placed in the pneumatic machine.

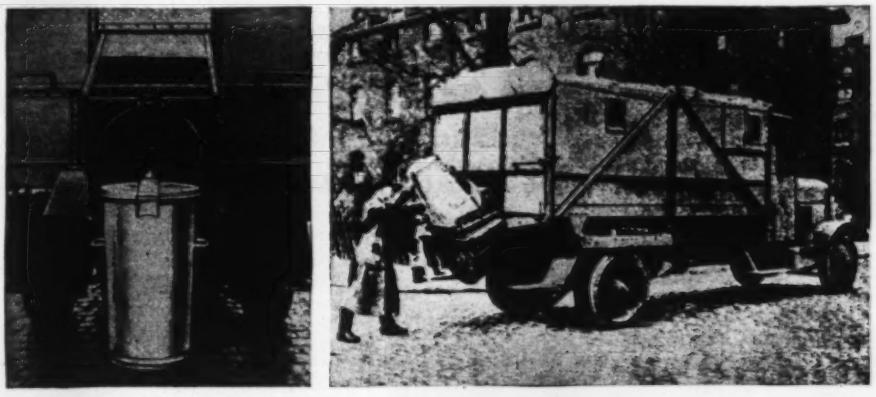
Experienced cement gun contractors have felt for some time that specifications should be more flexible in respect to the sand-cement mix, enabling them to take advantage of our present knowledge of bulking of sand to produce a gunite of greater uniformity than is possible under specifications as now commonly written.

Garbage and Refuse Collection and Disposal in Austria, Germany, France and Italy

Travel Notes on Can Systems and Collecting Wagons Used and on Disposal by Dumping, by Incineration With Utilization of Heat and Residue, and by Beccari Fermentation Process With Utilization of End Product

By C. M. Morssen
Civil Engineer, Montreal, Quebec

THE service for the collection and disposal of garbage and associated city refuse in some of the larger cities on the Continent of Europe is superior to the practice on this side of the Atlantic. In collection, more care is given abroad than here to keeping the refuse from being exposed to the air and blown about by the wind during collection and transportation, the chief means to that end being the use of covered cans and covered wagons, so designed that the refuse is emptied into the wagons without exposure to the air. In disposal, where incineration is used, utilization of both the heat and the residue of combustion is common in Europe, whereas in the United States heat is utilized but rarely and in Canada less frequently than in Europe, while in both these American countries there is scarcely any utilization of incinerator ashes and clinker.

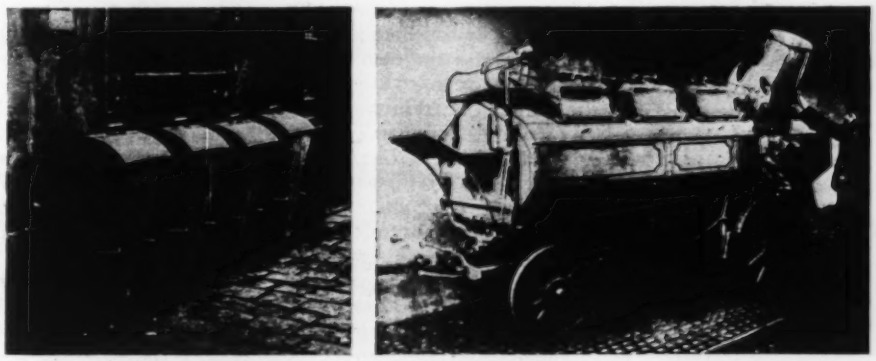


REFUSE CAN AND KRUPP TRUCK AT FRANKFORT, GERMANY
Left—Can ready to be lifted and emptied. Right—Can being emptied. Contents moved forward by means of worm gear.

In Italy, the Beccari fermentation process, dealing with garbage alone instead of with the mixed refuse that goes to the incinerators in the north of Europe has made more progress than in America, where until recently the only municipal plant of the kind was that of the village of Scarsdale, N. Y. [Since followed by five plants built or under construction in Florida—Editor.] The following notes, based on recent observations by the writer when abroad, deal chiefly with refuse collection in Germany and incineration in Cologne but give some information on incineration in Paris and the use of the Beccari system in Italy.

House Storage and House-to-House Collection—Three systems of house storage or can service are used in German cities: (1) a can for each householder; (2) large cans filled by several householders; (3) individual householder service, on the can-exchange system, differing from 1 and 2 in that for each can removed the collector returns one previously removed, emptied and cleansed. The cans used in the German cities visited were all of a standard size, very substantially built, and were owned and supplied by the city. Each can has a well-attached cover. The capacity of the can is 110 liters, or about 29 U. S. gal.

Wagons—The refuse wagons used in Germany are mostly all specially built auto trucks. Each truck has one or several specially constructed receiving chutes so arranged that the cover of the garbage cans fits exactly into the sliding or revolving cover of the chutes so that one removable cover engages with the other and both open simultaneously and no dust, garbage or other refuse comes in contact with the air or is scattered over the street during the process of dumping. The bodies or tanks are specially designed and the dumping chutes are kept very low to facilitate emptying the cans, at the same

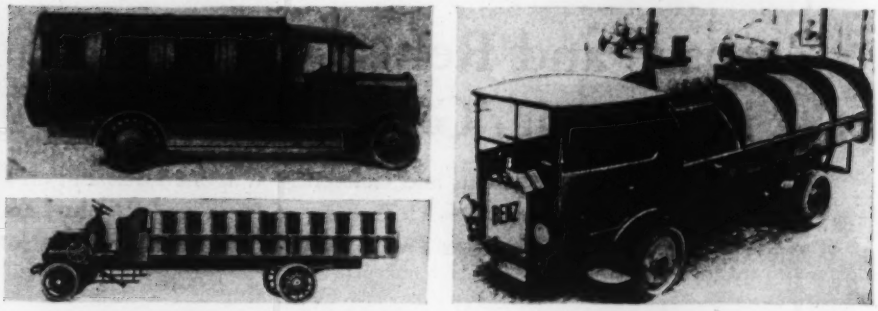


REFUSE CANS AND WAGONS, COLONIA SYSTEM; USED IN VIENNA, AUSTRIA
Cans emptied into wagon without exposure or scattering of contents.

Abstract of a paper read Oct. 10 before the Engineering Institute of Canada.

time to allow the tanks to be filled to capacity. The Krupp trucks are provided with interior worm gears and those of the system Neuy have revolving drums to distribute the garbage inside the truck bodies. Generally the trucks have a capacity of about 10 cu.m., or 13 cu.yd.

Where the can-exchange system is used, special platform wagons or trucks carrying 18 to 44 cans are used. To save in transportation charges, centrally located unloading stations are built where the full garbage cans are emptied into the large trucks and the cans washed and returned.



THREE TYPES OF REFUSE WAGONS USED IN GERMANY
Right—Used in many cities. Upper left—System Neuy. Lower left—20-can platform truck. Note sliding side openings in two of the views.

Collection System at Frankfort, Germany—To give an idea of the cost of such a system of refuse collection as has been outlined, the writer obtained data from the city of Frankfort, with a population of 460,000 and a daily garbage quantity of 750 cu.m., or about 980 cu.yd. Before the introduction of the present system, in 1926, the city had 100 horse-drawn wagons and the cans were of all sizes. Before the new method was adopted for the entire city it was tested in a single district. Based on the experience there, the city provided 34,000 cans of 110-liter capacity and 6,000 of 35-liter capacity; also 22 large and two small collection trucks and a 1½-ton repair truck. The cans were made by Schmidt & Melmer, Weidenau/S, and the trucks were supplied by Krupp, Essen.

The city was divided into two sections: in one, collections are made twice a week, totaling 3,340 cu.m., or about 4,400 cu.yd., weekly; in the other, there is a service once a week with a total of 720 cu.m., or 960 cu.yd., a week.

The collection trucks leave the municipal garage at 7:30 a.m. At the same time the can men, six for each truck, leave from central depots and begin immediately to carry out the cans from the yards or basements to the curb. As soon as a truck arrives the six men divide themselves into squads: three bring cans to the truck; two empty the cans into the truck; one returns empty cans. One of the men acts as working foreman. When a truck is full and is leaving for the dump, all men start again to carry out the full garbage cans. To fill a truck in summer 165 and in winter 150 garbage cans are required.

The men are paid for ten hours, and each truck makes four trips. If the work is finished in less than ten hours, the men are free. This arrangement gives very good results; the four daily trips for each truck are well maintained.

At the end of 1926 the garbage department employed in all 216 persons, subdivided as follows: 5 controllers; 10 blacksmiths and mechanics; 3 painters; 21 chauffeurs and drivers; 6 direction men; 114 can men; 18 laborers at the dump; 6 cleaners and exchange men; 5 electricians and drivers for electric trucks; 4 yardmen; 1 watchman; 1 storeman; 22 spare laborers to replace sick men. The average wages paid were: auto drivers, 10.9 marks, or $2.50; laborers, 9.27 marks, or $2.30; can men, 10.1 marks, or $2.40.

The daily expenses per truck were 205.72 marks, or $52, of which 78.94 marks, or $20, was for the truck alone and $32 for the can men. The handling of 1 cu.m. of refuse, including interest and wages, cost $1.10, or 82.5c. per cu.yd. The cost of emptying one can was 9c. The cost of disposal 1 cu.m. at the dump was 9c., or 6.75c. per cu.yd. Each truck was 52 days out of working order during the year. Each truck made four trips a day. The average haul was 3.5 miles. The useful capacity of cans was 72.4 per cent. The average time taken to carry out one can was 2 minutes, 44 seconds, and to empty it into the wagon, 32 seconds. The time lost by the trucks at the dump was five minutes. The weight of 1 cu.m. of garbage was about 500 kg., or half a ton.

The initial capital expenditure for the modernization of the garbage department of Frankfort was 1,600,000 marks, or $408,000, distributed as follows:

22	large trucks at $8,000	$176,000
2	small trucks at $5,000	10,000
1	repair truck	3,000
4	watering tanks bodies at $1,250	5,000
34,000	garbage cans at $4.50	153,000
6,000	small garbage cans at $2	12,000
22	exchange or spare chutes	2,000
1	1½-ton repair truck	3,500
1	wash machine	750
	Paving of yard and garage	15,000
	Planks for roads at dump	10,000
3	automobiles	18,500
		$408,750

Comparing the expenditure of the new system with the one used up to 1926, the modern system showed a saving of 25.6 per cent, after making allowance for interest and amortization charges. In addition to this saving in expenditure, the old system required 100 horse-drawn wagons and three collections a week, whereas the new system requires only nineteen trucks and two collections a week. The advantages of the new system are obvious and one city after another is adopting it.

To cover the expenses of the refuse collection, the city imposes a tax of from 1.75 to 1.45 per cent on the rental value of each house. A house having a rental value of $2,500 pays $44 a year for the refuse service.

Disposal and Utilization at Paris—Paris has four huge incinerators which produce clinker, cement, brick and other building materials on a large scale. The brick sell at $8 a thousand, against $12 for ordinary brick. The city builds the plants and makes any improvements which may be necessary, and the running of each plant is left to a private company, which supplies the working capital and employs its own men. From the revenue, the company pays all running expenses, salaries and interest on the working capital. To avoid paying interest on watered stock, the working capital cannot exceed 10 per cent of the cost of the plant. Any surplus left is turned over to the city.

Utilization at Cologne—Cologne, Germany, has an up-to-date utilization plant which is equipped with the most modern machinery to segregate, incinerate and utilize the

city refuse. The material arrives in huge closed auto trucks and through movable hoppers is dumped on to shaking belt conveyors. Magnetic pulleys extract all metals, and artificial draft removes the dust; the remainder goes into furnaces the heat of which is used as stated farther on. The dust and ashes are mixed with lime, coke and silicate acids and fused into a "lava" from which paving and building materials are cast. The "lava" has the appearance of natural basaltic lava and stands a pressure of 4,400 kilos per square centimeter.

It is claimed that from 165,000 tons of refuse the following was obtained: 102,000 tons of steam, used to produce 14,400,000 kw.-hr. of electric current; 13,000,000 building blocks of a resistance of from 35 to 150 kilos per square centimeter; 5,000,000 paving blocks of 380 kilos per square centimeter; 6,750,000 paving flagstones of 3,000 kilos per square centimeter; 4,950 tons of scrap metal and waste; and all the necessary hot water for heating, washing and shower baths.

The writer was greatly impressed by the magnitude of this plant and its scientific and hygienic operation. Nowhere could any refuse be seen. All was handled by inclosed conveyors and stored in closed bins. The plant cost more than $2,000,000 and it appears that the revenue from sales covers the running expenses and interest. The plant was designed and built by Musag, Ltd., of Cologne, Germany. I may add that in Europe in many instances the cities are obliged to utilize the by-products of incineration, as there are no dumping grounds available at any reasonable price.

Beccari System—In Italy the writer visited some Beccari installations for transforming garbage into a commercial fertilizer for fermentation. Garbage free from metal, glass, paper and rags is placed in reinforced-concrete bins of about 20-cu.m., or 26-cu.yd., capacity, the bins closed and the material held for from 25 to 30 days. The garbage is transformed into a dark, odorless humus which has a very high fertilizing value and is sold at $7 to $10 a ton.

Cannes, on the French Riviera, has just completed such a plant, which has, if I remember rightly, 100 cells. The operating company is pleased with the results. The writer visited the place and interviewed the operating company and also the city engineer of Cannes, who are pleased with the plant. The fertilizer produced is quickly sold to the gardeners of the neighborhood.

Treated Sewage and Laundry Waste for Auxiliary Water Supply

WATER for the resort hotels and camps on the south rim of the Grand Canyon of the Colorado River at the end of a branch line of the Atchison, Topeka & Santa Fe Railway is brought in tank cars with a haul of 100 to 120 miles. The daily consumption is 60,000 to 100,000 gal., at a cost of $3.09 per 1,000 gal., but a supply for boiler feed, sprinkling lawns, flushing toilets and cooling the cylinders of oil engines is obtained at a cost of about 57c. per 1,000 gal. by utilizing effluent from the local sewage-works specially designed for this purpose. As described by H. B. Hommon, sanitary engineer in the U. S. Public Health Service, in Bulletin 317 (July, 1929) of the American Railway Engineering Association, a plant consisting of septic-tank and filters was installed originally by the railway, but the effluent could not be used for lawn sprinkling near the hotel on account of the odor. With the increase in number of visitors, extensive improvements became necessary in 1924, and as the problem of water supply became acute it was decided to include a sewage-treatment plant of such nature that its effluent could be used for as many purposes as possible instead of fresh water.

This treatment plant comprises the following features: (1) screen chamber with bar screen; (2) preliminary settling tank with 30-minute detention period at maximum flow; (3) two aeration tanks 42x8 ft. in plan, and 8 ft. deep, designed to handle 200,000 gal. daily with six-hour aeration period; (4) clarifier tank 16x16 ft. and 11½ ft. deep, with scraping device and a detention period of 2.8 hours; (5) secondary settling tank 16x4 ft. and 10 ft. deep; (6) two rapid sand filters of 77 sq.ft. each; (7) wash-water tank; (8) clear well 16x16 ft. in plan and 5½ ft. deep, with capacity of 10,500 gal.; (9) wash-water recovery tank 25x16 ft. in plan and 4½ ft. deep, 13,500-gal. capacity, from which the water is pumped back to the preliminary settling tank; (10) two 4-in. centrifugal pumps delivering the reclaimed sewage to a 200,000-gal. tank level with the ground; (11) two air compressors with rotors revolving in water to wash the air, each having a capacity of 200 cu.ft. per minute; (12) a semi-automatic machine for applying liquid chlorine to the reclaimed sewage; (13) equipment for applying a sodium-hypochlorite solution if for any reason the liquid chlorine cannot be used.

In 275 tests of samples of the treated effluent from June, 1926, to March, 1928, only twelve, or 4.4 per cent, were positive for B. coli. Routine bacterial analyses in 1928 showed that 99.98 per cent of the bacteria growing on agar was removed by the treatment plant; 99.84 per cent of the B. coli in raw sewage was removed by the aeration tanks and clarifier, while 99.99 per cent of the B. coli was removed by the plant as a whole.

Laundry waste was then studied with a view to making it suitable for boiler feed, without causing foaming. Analysis showed that the hardness was due to carbonates and bicarbonates. As 86 per cent of these constitutents was removed from the sewage in the treatment plant, it was not considered necessary to treat the waste, which was simply mixed with the raw sewage. In this way "the amount of reclaimed sewage approaches very closely to 99 per cent of all water discharged into the sewers."

At present the reclaimed sewage is used in stationary and locomotive boilers, as cooling water for oil engines, for irrigating lawns and for flushing toilets at the hotel, tourist camps and railway station. It may be used also for washing automobiles. The locomotive enginemen made vigorous opposition to the use of the sewage effluent at first, but found that it produced less scale than the fresh water obtained at the canyon. A sanitary engineer is in charge of the plant and has two trained assistants. Cost of treatment is about $0.574 per 1,000 gal., including interest on investment and depreciation.

It is pointed out that the plant produces an effluent of the same degree of purity as drinking water, from the bacterial standpoint, and that every 1,000 gal. of reclaimed sewage that can be used instead of fresh water saves $3.09 for water, minus cost of sewage treatment, or, say, $2.50 net saving. The author believes that with such treatment, where there is a scarcity of water it will be economically practicable to reclaim sewage for industrial purposes and for irrigating crops without danger of contaminating groundwater or the produce.

Efficient Concrete Plants on Two Building Jobs

Los Angeles Contractor Repaid for Careful Study of Existing Conditions in Designing Layouts for Hospital and Apartment House—Labor Required Cut to Minimum

By Zara Witkin
Chief Engineer, Herbert M. Baruch Corporation, Los Angeles, Calif.

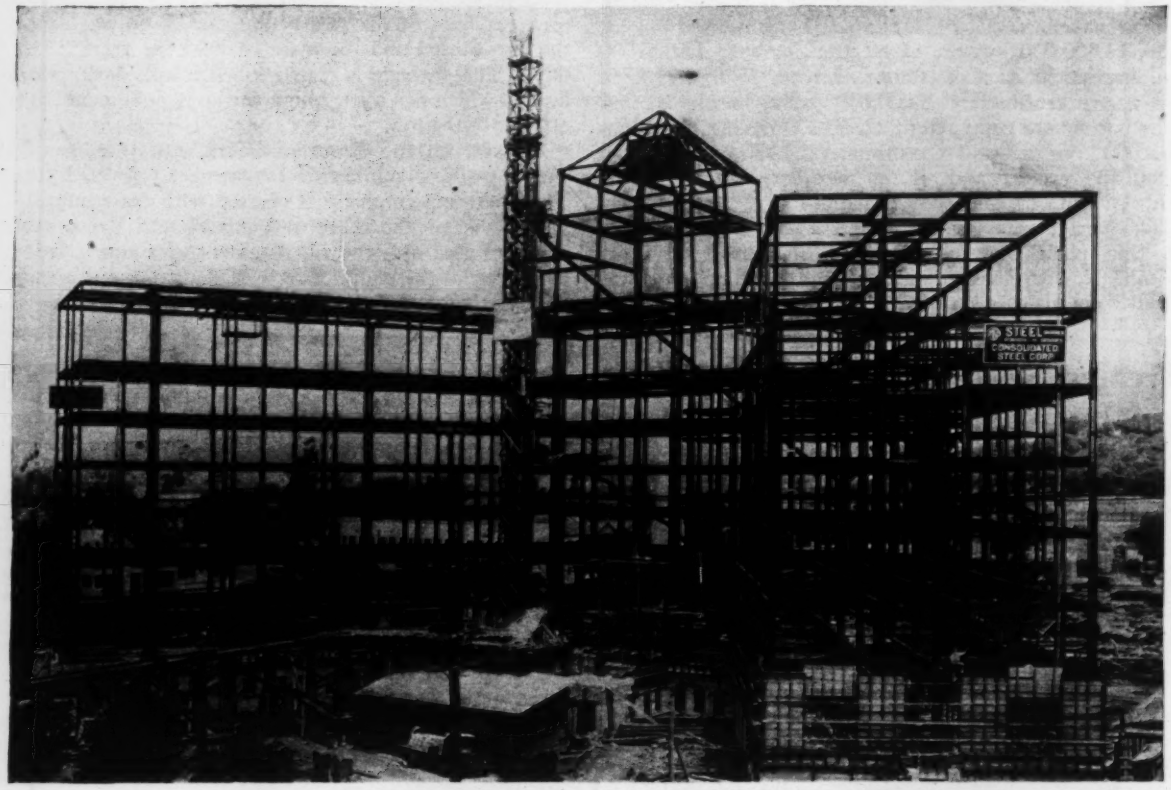


FIG. 1—CONCRETE PLANT LAYOUT FOR LOS ANGELES HOSPITAL
Plant for material trucks shown at lower left. High line chutes suspended from a cable delivering concrete to nurses' home at rear of main building. Lower chute line hanging from boom is delivering concrete to lower portions of main structure.

PREPLANNING the plant and concreting operations for every element of the work on a building job is vital and yields, if well done, continual premiums during the construction of the project. The economic success of building every concrete structure rests primarily upon the efficiency and flexibility of the plant layout. If badly planned, the main volume is penalized throughout the job and smaller portions of the project, inaccessible to the general concreting system, necessitate special and usually expensive conveyance and placement equipment, often adding appreciably to the average unit cost.

Two examples of preparatory studies which were tested in practice with thoroughly satisfactory results are presented in this article; one, the Cedars of Lebanon Hospital, a structure of two units containing 10,000 cu.yd. of concrete, and the other, the Jacob Kalb Apartments, containing 3,100 cu.yd. of concrete. In each case the working drawings of the plant were made before the job was started.

In designing the plant layout the concrete plants are considered as consisting of five parts: (1) driveways for concrete material trucks; (2) aggregate and cement storage bunkers; (3) measuring hoppers and mixer; (4) hoist and tower; (5) concrete-conveying apparatus from tower hopper to point of deposition. Each of these elements is basically affected by height, shape and size of the structure to be built, by the location of the structure as regards traffic conditions and by the topography of the site and adjacent ground. It is only after the effects imposed by these factors are met in the individual case that the criteria of efficiency and economy can be applied, since more economical and easily handled plants might be designed, but space, traffic and topographic conditions preclude their use.

Hospital Plant—The hospital job is an eight-story structural steel-frame building with concrete walls and floors, with the main portion of the building consisting of two wings opening into a flat V. At the juncture of the wings a tower rises to a total height of 145 ft. above grade, or 45 ft. above the main building roof. Behind the main building is the nurses' home, also an eight-story building and of the same construction. A two-story service structure connects the two buildings.

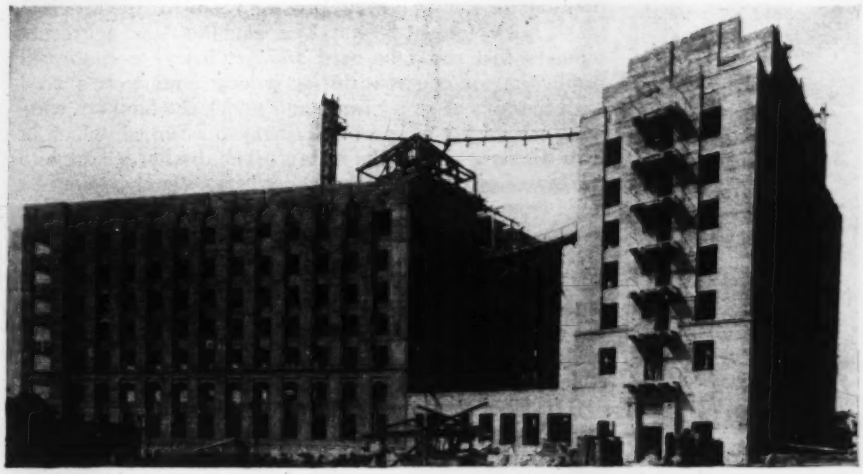


FIG. 2—NEARLY COMPLETED STRUCTURES SHOWING FINAL POSITION OF HIGH LINE CHUTES

Main building shown on the left and nurses' home on the right. Note vertical wooden chutes on rear of nurses' home which delivered concrete to the ground level and mortar topping to all floors from the main central plant.

The hospital is located on nearly level ground, with considerable available area outside the building line subject to little interference by passing traffic. The first problem in planning a plant layout was to determine whether to set up two mixers fed by two pairs of bunkers serving one high and one low tower, or to use one large mixer, so located as to serve a single tower, higher than either of the two required as an alternative, which could, by chuting, deliver concrete to all levels and areas of both buildings. By careful study it was determined that the latter plan was less costly in installation and operation. Another factor entering into consideration was that the progress schedule had been arranged to allow the nurses' home unit to be started and completed earlier than the main building, the various subcontractors following in sequence from one structure to the other.

A decision on the single plant layout narrowed the possible position of bunkers, mixer and tower locations to two sites, one in the opening of the wings of the main building and the other between the main building and the nurses' home. Analysis of these alternatives showed that the chuting could be more flexible and shorter lengths used by setting the tower in front of the main building. This arrangement allowed the space between the two buildings to be used for handling the heavy mechanical equipment, such as boilers, which would have been impossible had the concrete plant been placed in this location. Consequently, arrangements were made to concrete the nurses' home unit by a cable-supported chute line suspended from the high tower and the structural frame of both buildings, with the chute running through the steel of the main building (Fig. 1). Auxiliary chutes led from the end of the main chute to all areas in the nurses' home. The main chute line was approximately 225 ft. long and was set on a 1 on 4 slope. Only one shift in height of this chute was required during the job. A diagram of the plant layout is shown in Fig. 3.

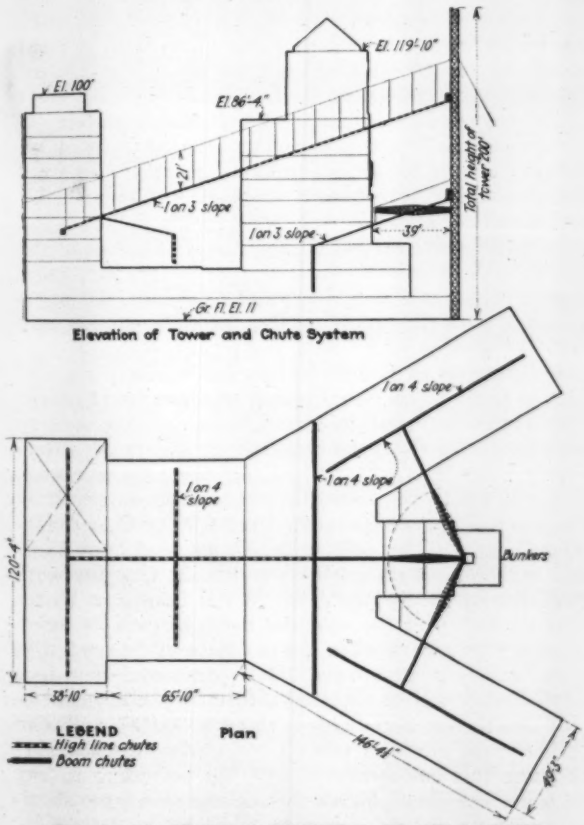


FIG. 3—DIAGRAM OF HOSPITAL PLANT LAYOUT

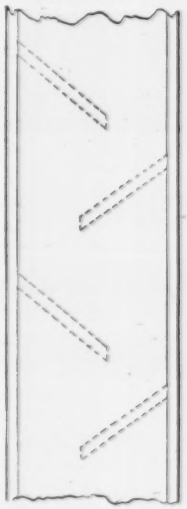


FIG. 4 — DETAILS OF BAFFLE BOX VERTICAL CHUTE

For concreting the main building from the same tower, a single separate chute line carried on a latticed boom could be swung to either wing of the main building, and auxiliary chutes carried the concrete to final position. In this way no carting was required for the structural concrete, and pouring on both buildings proceeded simultaneously without interference, the tower bucket delivering to either the high-line chute or to the lower boom chute.

For pouring sidewalks and roadways around the nurses' home and to handle the mortar topping for the floor slabs of this unit, an ingenious adaptation of the plant was arranged to use the central plant. A 12x18-in. wooden box chute was set vertically on the rear elevation of the nurses' home at the end of the chute line (Fig. 2). To prevent segregation of the concrete, a series of baffle plates was built into the box, arranged as shown in Fig. 4. By this arrangement material could be received from

FIG. 5—VIEW OF CONCRETING OPERATIONS ON APARTMENT HOUSE

the main chute and brought down to any desired floor level or to the ground. The labor forces needed to operate the plant once the chutes were set in position consisted of one man for the rock hopper, inundator and mixer, two on the cement platform and one hoistman.

Apartment House Plant—Designing the plant for the apartment house, an eight-story reinforced-concrete building, was a problem quite different from that of the larger hospital structure. Confronted here by a situation where no space whatever was available within the building lines, it was necessary to provide an adequate plant occupying the least possible room, with the maximum concentration of its elements.

This was accomplished by carrying the main excavation outside the lot lines to provide room for the concrete plant below street level. The smallest size aggregate bunkers that could be used and yet insure a continued production of concrete during a long pour were placed with the tops at street level, and under the bunkers were hung measuring hoppers delivering to a funnel, which in turn discharged into the mixer. The discharge was into the center of the drum, the mixer being swung around 90 deg. from the customary position. The mixer in turn dumped into the hoist bucket in a tower which was erected alongside the bunkers. In this manner the overall width of the plant was held to 10 ft., the total length over the bunkers and tower was approximately 28 ft., and the total height of the plant was held to a minimum (Fig. 5). Movable boom chutes, as shown in Fig. 6, reached to all parts of the building.

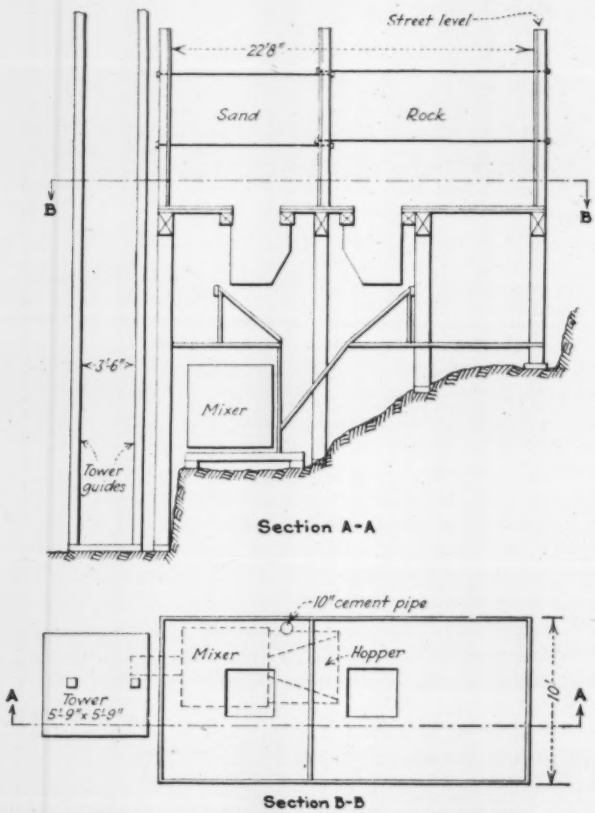


FIG. 6—DIAGRAM OF APARTMENT HOUSE CONCRETE PLANT

The labor used on this plant consisted of one man for the aggregate hoppers and mixer, one hoistman engineer and two men handling cement and the concrete admixture.

Both structures were erected by the Herbert M. Baruch Corporation, of Los Angeles, Calif. The plant layout of the hospital was largely the work of Herbert Pomfret, superintendent, and M. Goldsmith, assistant superintendent. The apartment house plant was designed by C. W. Morser, superintendent, and Frank Post, assistant superintendent.

Conservation Urged as California Cities Face Water Shortage

Appeals to the citizens of both Los Angeles and San Francisco, urging the voluntary conserving of the domestic water supplies, have recently been made by officials of both of these cities, as the continued lack of rain has caused serious depletion of the stored supplies. In each case users were requested to refrain from unnecessary lawn sprinkling, to have leaky faucets repaired and, in general, to conserve the existing supply. The present situation results from a series of subnormal rainfall years which have gradually reduced the holdover storage in the reservoirs. The condition has been aggravated recently by one of the driest autumns on record in California, resulting in extreme shortage in the available water supply. The Los Angeles stored supply was reported as 38 per cent less on Dec. 15, 1929, than at the same time the previous year. The San Francisco water situation was stated to be, with one exception, the worst on record, with the supply on Dec. 31 sufficient for only a 180-day period.

The situation in San Francisco has resulted in a decision to begin at once the sinking of about twenty wells to tap water-bearing strata known to exist in the western part of the city. Water pumped from these wells would provide an emergency supply if that becomes necessary. The wells will be about 300 ft. deep and the supply from this source is expected to total from 6,000,000 to 7,000,000 gal. daily. The wells will be connected by a 15-in. main to the distribution system within the city, the work being done by the Spring Valley Water Company. Under an agreement with the city, the company will be reimbursed for this work when the purchase of its properties by the city is consummated. It is estimated that four months' work will be required before the wells would be ready and the estimated cost is about $250,000. Sufficient rainfall in the next few months will obviate the necessity for using this emergency supply, but according to city and water company officials the seriousness of the shortage makes the safety precaution advisable.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Applications of Reinforced Concrete

VORLESUNG UBER EISENBETON—By Dr. E. Probsts, Professor Institute of Technology, Karlsruhe, Germany. Volume II, 2d Edition. Berlin: Julius Springer. Cloth; 6x9 in.; pp. 540; illustrated. 31.5 marks.

REVIEWED BY L. J. MENSCH

Designer and Builder of Reinforced Concrete, Chicago, Ill.

These lectures on the applications of reinforced concrete are written for the advanced or post-graduate student by an engineer who has been in actual practice and who has made repeated visits to the United States. In his introduction the author states that the simplest way to analyze the safety of any structure is the most scientific, and that the design and the construction of reinforced-concrete structures ought to be concentrated in one hand. The first recommendation is rarely followed in his country, while the second one is rarely followed in this country. Based on the fundamental formulas treated in his preceding volume, Professor Probsts selects example of buildings, shed roofs, grain elevators, bridges and water-works, actually built, and analyzes every detail from beginning to end.

American engineers who are not familiar with European practice can learn a great deal from this book. They will find that instead of the American practice of calculating the bending moments of girders by the standard formulas of $\frac{wl^2}{8}$, $\frac{wl^2}{10}$ and $\frac{wl^2}{12}$ for dead and live load regardless of the relative spans and sizes of the connecting girders and columns, Professor Probsts advises as a rule much smaller moments for the midspans and larger moments over the supports, and the moment coefficients given are different for live load and dead load, as ought to be the case.

The bending moments which occur in the connecting columns are thoroughly and simply analyzed, and the hooking of column bars is insisted upon, especially in the roof story, a detail which is here universally neglected and often results in cracking of the columns underneath the roof. The chapter on bridges is extensive and very complete with many illustrations. Examples are worked out in detail of continuous-girder bridges, three-hinged arches and fixed arches. Interesting also are the chapters on large conduits, retaining walls, sea walls and locks. The chapter on foundations is rather short and not so good as the others.

Flat slab floors are treated in the old theoretical German manner. The discussion is not based on as much information as is offered in the American literature on the subject; but the influence of the bending of the slabs on the bending of the columns is treated in a much more rational manner than on this side of the Atlantic. The material on dams is a recapitulation of the many articles on this subject which have appeared in the *Transactions* of the American Society of Civil Engineers in the last fifteen years.

Engineers who want to know European practice and who do not have Emperger's encyclopedic handbook on reinforced concrete on account of its price ought to have this book in their library.

National Regional and City Planning

OUR CITIES TODAY AND TOMORROW: A Survey of Planning and Zoning Progress in the United States—By Theodora Kimball Hubbard, Hon. Librarian, American City Planning Institute, and Henry Vincent Hubbard, Norton Professor of Regional Planning, Harvard University, Editor of *City Planning*. Cambridge: Harvard University Press. Cloth; 7x10 in.; pp. 389; illustrated. $5.

REGIONAL SURVEY OF NEW YORK AND ITS ENVIRONS: Vol. VIII, *Physical Conditions and Public Services*—By Harold M. Lewis [Executive Engineer] with Contributions by Theodore T. McCrosky and Raymond A. O'Hara, of the Engineering Staff [and others] and Some Concluding Observations on the Regional Survey by Thomas Adams [General Director]. *The Graphic Regional Plan: Atlas and Description*, Vol. I—Prepared by the Regional Staff. New York: Regional Plan of New York and Its Environs, 130 East 22d St. Each volume, cloth; 8½x11 in.; pp. 209 and 416; maps, diagrams and halftone views; the second volume has colored maps, some folding.

PLANS AND STUDIES, WASHINGTON AND VICINITY—Supplementary Technical Data to Accompany Annual Report (1928) of the National Capital Park and Planning Commission. Paper; 6x9 in.; pp. 49; maps and halftones, many on folding plates. 50c. from Superintendent of Documents, Washington, D. C.

NORTH MIDDLESEX REGIONAL PLANNING SCHEME—Report Prepared for the North Middlesex Joint Town Planning Committee by Adams, Thompson & Fry, Town Planning Consultants, Westminster, England. Boards; 10x12 in.; pp. 80; halftones, large folding and other maps, some colored. 10½ shillings from Ernest S. W. Hart, Honorary Secretary, Clerk to the Middlesex County Council, Guildhall, Westminster, S.W.1, England.

WHAT ABOUT THE YEAR 2000?—An Economic Summary—Prepared under the direction of Joint Committee on Bases of Sound Land Policy, Organized by the Federated Societies on Planning and Parks, Composed of the American Civic Association, American Institute of Park Executives, American Park Society, National Conference on City Planning and National Conference on State Parks. Cloth; 5x8 in.; pp. 168; illustrated. $1 from Federated Societies on Planning and Parks, 901 Union Trust Building, Washington, D. C.

CITY PLANNING: A Series of Papers Presenting the Essential Elements of a City Plan—Edited by John Nolen. Second Edition, New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. 513; illustrated. $3.50.

Within a quarter-century, city planning has gained recognition, and from it we have gone on to regional, state and national planning. The two last, most of the second and much of the first, it is true, are still on paper and still are private rather than public efforts. In each field preliminary surveys, mostly conducted by private agencies, have been necessary to awaken public interest and thus gain official support. As a result, reports and books are growing in number and value. A number of these are noted below. They range from preliminary surveys of fields where little or nothing has yet been done to reviews of progress and deal with the whole range of planning, from national to local, including a British study of regional planning needs for three-fourths of a million people adjoining London on the north.

By far the most comprehensive and best presented survey of city, county and regional planning ever made in this or any other country is Our Cities Today and Tomorrow, by Professor and Mrs. Hubbard. The book is based largely on field surveys in 120 cities and fifteen counties and regions by Howard K. Menhinick but reinforced by the intimate knowledge of the joint authors and editors. The cities surveyed include all in the United States having a population of 200,000 or more, while below that size cities representative in various ways were chosen, ranging downward in population to about 6,000. To insure like coverage of each city and region, the field man was armed with a schedule proposed by the authors,

while to avoid getting into ruts he was in constant communication with them.

Instead of dry-as-dust categorical summaries of what Mr. Menhinick learned in each place visited the Hubbards have presented the data and deductions from it in thoroughly readable form under eighteen main heads. The first nine of these are present status and legal and administrative background, municipal, regional and state planning, educational work, technical procedure and financial programs and comprehensive plans in action. The next seven chapters deal with the following planning elements: land subdivision, zoning, major street plans, rail, water and air terminals, ports and recreation, and civic centers. This part of the book closes with chapters entitled It Pays to Plan, and Lines of Future Progress. The discussion is non-academic, free from dogmatism, rational and stimulating.

Approximately the last fourth of the book consists of highly condensed, classified summaries of the findings of the survey, for ready reference and comparison each arranged alphabetically by cities. Among these are notes on appropriation and staff organizations of 57 cities; benefit assessments, plotting control, benefits of zoning, grade-crossing eliminations, civic centers, and elimination of overhead wires.

One of the most useful parts of the final section of the book is a descriptive directory of the cities and regions visited by Mr. Menhinick, with page references to the body of the book which sometimes number scores. As would be expected in so well executed a book there is an extensive subject index.

Inadequate as the foregoing notes are to indicate the contents and excellence of the book, they should be sufficient to show its value to the rapidly growing number of men and women now either directly engaged in city and regional planning or else backing the movement to remedy some of the past neglect in that field and to meet the ever-multiplying demands of the future.

With the publication of two handsome volumes on the Regional Survey of New York and Its Environs the monumental series of reports of which they form a part is all but completed. Vol. VIII of the regular reports is the last of that series, but a second volume is required to complete The Graphic Regional Plan. It should be added that besides the eight volumes of the report now completed a number of small monographs have been published.

The survey covers an area of 5,528 square miles, located in three states, embracing over 400 cities and lesser minor civil divisions, with a total population of some 10,000,000. It was financed privately, chiefly by the Russell Sage Foundation. In its making, many engineers, landscape and other architects, lawyers, vital statisticians, political and social scientists and other specialists contributed. Engineering leader from the start of the survey until his death was Nelson P. Lewis, who for years before the survey began was chief engineer of the Board of Estimate and Apportionment of New York City.

The first of the two volumes before us takes up the geography and climate, water supply and sewerage, refuse disposal and oil pollution, power, light and other services, and the supply and distribution of commodities. Hospitals and prisons are then considered, as also earlier planning efforts in New York and its environs. The final chapter presents various concluding observations, among which are problems requiring further investigations, and looks both backward and forward. Numerous maps, other illustrations and tables supplement the text.

Vol. I of The Graphic Regional Plan, as its name implies, is a graphical presentation of the survey, and with the second volume will be the Final Plan. It abounds with illustrations, including a long series of colored sectional maps (based on U. S. Geological Survey maps) showing the Regional Plan in atlas form. The volume then presents the main elements of the plan, including ways of communications and land uses. Some of the maps in this part of the report were reproduced in *Engineering News-Record*, June 6, 1929, p. 907. An abundance of well-chosen photographs are handsomely reproduced.

Whatever the outcome of spending so much money and expert knowledge as have been devoted to this survey may prove to be in terms of adoption by the communities embraced in the regional area, the survey and the volumes recording its results will always stand as a noble monument to those who conceived and executed the Regional Plan of New York and Its Environs.

The family resemblance of regional planning studies everywhere is shown by the report on the problems of North Middlesex, a region with some three-fourths million population, adjoining the administrative county of London, England, on the north. The report takes up topography, zoning, transport facilities, main highways, waterways and open spaces, all much in line with an American report. A section rarely appearing in an American planning report deals with Protection of Amenities, both natural and architectural. The region considered falls into three parts: urban, adjacent and similar to the London area; suburban; rural, the latter already beginning to show the outward push of urbanization from London. A green girdle between the suburban and rural zones is proposed. Application of zoning is urged, as also other planning activities to meet local needs. No proposal is made for a regional agency of government. Repeated mention is made of broader studies of the Greater London Regional Planning Committee. The head of the firm making the report is Thomas Adams, director of the Regional Survey of New York and Its Environs.

The present status of the plan of our national capital and the changes leading up to it through the century and more since the L'Enfant-Washington-Jefferson plan, as modified by Ellicott, are set forth in a pamphlet consisting largely of maps recently published by the commission which now has in charge the continuance of planning work in Washington and its extension into the surrounding area. Much of the text summarizes the present uses to which the land in question is put.

What About the Year 2000? has been chosen as the title of a condensed summary of a series of studies of national problems centering in land utilization in the United States and what population our widespread area, with its varied resources and, in some cases, its very limited productiveness, may be expected to support at the close of this century—not forgetting important contributions from other countries, which are increasing at a rate which may well be surprising. The collaborators in this study (named above) consider our land resources, population, urban uses of land, public, scenic and recreational areas, forestry and agricultural uses of land, progress of planning (urban, sectional and national) and next

steps thought desirable. A bibliography follows. The survey is well presented and should appeal to many thousands, because of its importance to every thinking citizen and because its nominal price of a dollar brings it within the reach of anyone.

John Nolen, a dean of city planning, has brought out an enlarged and (in parts) revised edition of his wide-ranging collection of papers on city planning, first published in 1916. Zoning, in its infancy when the book first appeared, has a new chapter by Edward M. Bassett, a well-known pioneer in this field. Regional Planning, scarcely known even by name in 1916, is newly treated by the editor of the volume. Alfred Bettman has rewritten his chapter on City Planning Legislation, and Frederick Law Olmsted has rewritten his Introduction. The lists of references have been revised. Engineer contributors to the volume include C. M. Saville, on Water Supply; E. P. Goodrich, Waterways; George R. Wadsworth, Railways and Industrial Districts; B. A. Haldeman, Transportation and Main Thoroughfares and Street Railways; J. V. Davis, Rapid Transit. As a handbook on city planning, not too technical for laymen, public officials and the general reader, nor too popular for engineers who have not specialized in the subject, the book is commendable. Why airports are not included in the new matter the editor does not explain.

Highway Location, Curves and Earthwork

HIGHWAY CURVES—By Howard Chapin Ives, C.E., Consulting Engineer. New York: John Wiley & Sons. London: Chapman & Hall. Flexible: 4x7 in.; pp. 247; illustrations and tables. $3.50.

Here is a handbook which, although written in the familiar manner of railroad location and earthwork handbooks, is intended expressly for the highway engineer. The title is rather misleading, as highway curves take up but a portion of the book, which is proper for a work of this sort, as curves are but a portion of the highway engineer's problems. However, Mr. Ives goes into the discussion and solution of curves very thoroughly, not only simple curves, but compound, reverse, vertical and spiral curves. Widening and superelevating and banking curves are well treated. Essentials of highway location are given in one chapter. The treatment of earthwork problems is direct and brief. Slope-stake setting, mass diagrams and haul, and earthwork calculations all come in for a short survey. The determination of true north and the care and adjustment of instruments are given a rightful place in the volume. Thirty-six tables, including those covering curves, trigonometry, lengths of arcs, stadia reduction, earthwork volumes and azimuth of polaris until 1935 complete the volume. In short, this is a handy and useful addition to highway engineering literature.

Our No Longer Illimitable Universe

THE UNIVERSE AROUND US—By Sir James Jeans, M.A., D.Sc., LL.D., F.R.S. New York: The Macmillan Co. Cambridge, England: University Press. Cloth; 6x9 in.; pp. 340, including index; illustrated. $4.50.

Outstanding among the books of 1929 was The Universe Around Us. The author has in eminent degree the faculty of presenting highly technical subjects so they are not only readily understood by general readers but will appeal to their imagination and stimulate thought. Of his six main topics, the first three center in Exploring —the Sky, the Atom, Time. Next come Carving the Universe, Stars, and Beginnings and Endings. The end of human life in our own part of the universe is put by the author at a million million of years. The author believes that this earth of ours is the only portion of the universe inhabited by human beings. He accepts the theory that the universe no longer can be rightly conceived as illimitable. Somewhere space comes to an end; but although without boundary one could no more step off the universe than off the world. If this seems incredible to those who have always believed in a beyond the beyond they should refer to The Universe Around Us for a more detailed explanation.

Reinforced-Concrete Structures

REVIEWED BY LEON S. MOISSEIFF
Consulting Engineer, New York City

REINFORCED-CONCRETE CONSTRUCTIONS: The Systematic Course, Part II [Printed in Russian]—By John Podolsky. Paper; 7x10 in.; pp. 104; 32 line cuts. Address the author, Mashkof per D.I.A.K.F., Moscow Center, Russia. (U.S.S.R.) 4.5 rubles ($2.25).

Earlier works of Professor Podolsky have received favorable notice in *Engineering News-Record*. The volume at hand forms the second part of the systematic course on reinforced-concrete structures taught by the author at the hydraulic faculty of the Moscow Institute of Engineers of Transport.

It contains detailed computations of various structures in reinforced concrete, especially such as find their application in hydraulic developments. It contains six fundamental chapters which treat of: bases for columns and trusses; reinforced-concrete piles; reservoirs, cylindrical, rectangular and spherical; reinforced-concrete bins; retaining walls for hydro-technical structures, and circular reinforced-concrete tubes. As in Professor Podolsky's previous works, the treatment is clear and practical. While most of the methods and procedures are well known, there is always an attempt to clarify and simplify the problem.

The book will prove useful to Russian students and engineers who will have constant occasion to apply it on the extensive construction work that is now being carried on in U.S.S.R.

Notable Municipal Ownership Survey

THE CHANGING CHARACTER AND EXTENT OF MUNICIPAL OWNERSHIP in the Electric Light and Power Industry—By Herbert B. Doran, Research Associate in the Institute, Assistant Professor of Economics in Northwestern University, School of Commerce. Research Monograph No. 1. Chicago: The Institute for Research in Land Economics and Public Utilities, 337 East Chicago Ave. Paper; 7½x10 in.; pp. 102; charts and tables. $1.50.

With great patience and persistence Mr. Doran and a number of assistants have gathered and reduced to tabular and graphical form the changes in municipal ownership of electric light and power plants doing a commercial business in the United States. The period covered is from 1882, the inception of the industry, to 1927. The relatively small amount of text is almost wholly a summary of the statistics given. A "larger study and interpretation" is in progress, this being only a "preliminary report."

The survey is concerned only with changes in municipal ownership by original establishment, by purchase of privately owned plants and by sale of publicly owned plants. The data are given in various forms and cumulative combinations by years and by longer periods, not only for the entire country but for groups of states and

in lesser degree by separate states. Some of the data are also presented in accordance with whether current is generated or purchased. There is a section on length of life of municipal establishments, and finally one on municipal ownership in communities of different sizes. Even well-informed persons will be surprised to learn that of the 3,814 plants at some time municipally owned, nearly 30 per cent were in places of less than 500, 54 per cent in places under 1,000 and 84.5 per cent in places under 2,500. Only 44 places, or 1.15 per cent, were of 20,000 or over.

In the promised final report it is to be hoped that there will be added at least a brief summary of all plants, regardless of ownership, and of plants privately owned, and that the names and populations will be given of the relatively few places of more than 20,000 population that have had and now have publicly owned plants. We also suggest that the years since 1927 be covered by at least totals for the whole country of publicly owned, privately owned and all establishments, regardless of ownership. This is all the more important because of the many changes from public to private ownership in the five years ended with 1927 and the likelihood that the final report will not appear for a year or two. Everyone interested in the subject will wish to know whether the curve of municipally owned plants is continuing to drop at the rate of speed recently shown. In fact, most of those to whom such a study appeals would be willing to sacrifice some of the minuteness of analysis which abounds in this report for the sake of more up-to-date figures, even if the latest ones were in a minor degree approximate.

Solutions for Seven Problems

PROBLEMS IN THE THEORY OF RIVER ENGINEERING—By Herbert Chatley, M.Inst.C.E. London: Institution of Civil Engineers, Great George St. Boards; 6x9 in.; pp. 23; diagrams.

In this paper the author deals with seven problems for which he found no solution in available literature and for which he has worked out academic solutions of a kind in the hope that they may prove useful to others. The problems dealt with are (1) the convergence or flare of bank "normal" lines in a tidal river; (2) the effect of tidal change on instantaneous discharge; (3) salinity currents due to juxtaposition of salt and sweet water; (4) dimensional relation of river models; (5) non-turbulent flow in natural streams; (6) erosion of a channel bed in cohesive material; (7) stability of narrow dredged cuts in wide channels. For eleven years the author was employed on river work on the Whangpoo and Yangste rivers in China.

The Invincible Tractor Salesman

ALEXANDER BOTTS: EARTHWORM TRACTORS—By William Hazlett Upson. New York: Farrar & Rhinehart, Inc. Cloth; 5x8 in.; pp. 289; colored pictorial end papers and dust jacket by Tony Sarg. $2.

From Maine to California Alexander Botts sold Earthworm Tractors. Always he made a sale regardless of the type of "sales resistance" he met, the terrain on which the tractor was to be run or the use to which the tractor was to be put. Once a shrewd Vermont woman got the better of him—but that was with the aid of a letter from the home office; Botts not only got rid of the old tractor he took from her but but also sold to his customer another mass of junk. Again a salesman for a rival tractor got the laugh on him, but in the end Botts showed that he laughs best who laughs last. In another adventure our salesman won out against a motor boat and an airplane. Finally Bott makes sales against odds, wins a bride and a promotion. Throughout the book, which is mostly a series of daily sales reports in narrative form, one hardly knows which to admire most, the salesman or that marvel of the age, the slow but sure tractor.

For Every User of Rock Products

DIRECTORY OF THE ROCK PRODUCTS INDUSTRY: The Producers of Cement, Lime, Crushed Stone, Sand and Gravel, Gypsum, Slag, Slate, Silica, etc. Also a Buyers' Guide of Machinery and Supplies, 1929-1930. Chicago: Tradepress Publishing Corp., 542 South Dearborn St. (Publisher of *Rock Products*). Flexible; 6x9 in.; pp. 512; maps. $3.

This up-to-date directory of producers of cement, lime, crushed stone, sand and gravel, gypsum, slag and silica, arranged by states, is invaluable to contractors and others buying rock products. A key map of each state showing location of producers and a geological summary of rock-product resources head each state directory. Names and addresses of officials, location, number and capacities of plants, methods of loading and means of transport are given for most of the producers, supplying full information to those interested. Producers in Canada, Cuba, Mexico and parts of Central and South America are also listed. Besides being listed by states, each producer is listed by products in a general summary. A complete buyers' directory of machinery used in the rock-products industry is included.

Present-Day Labor Problems

LABOR PROBLEMS—By Gordon S. Watkins, Ph.D., Professor of Economics, University of California, at Los Angeles. Revised Edition. Crowell's Social Science Series, edited by Seba Eldridge, University of Kansas. New York: Thomas Y. Crowell Co. Cloth; 5¼x8 in.; pp. 726; charts. $3.50.

Because the triumph of machines in the past decade has so influenced the status of the American wage earner is one reason why Dr. Watkins has thoroughly revised his book on Labor Problems, first published in 1922. He states that the developments in the labor movement, changes in labor legislation and in proposed solutions of the problems of labor relations have made the revision of the original text imperative. A lengthy review of his original book was given in these columns Jan. 18, 1923.

Publications Received

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

BERECHNUNG DES EISENBETONS Gegan Verdrehung (Torsion) und Abscheren—Von Dr.-Ing. Ernst Rausch, Privadozent an der Technischen Hochschule, Berlin. Berlin: Julius Springer. Paper; 7x10 in.; pp. 50; 59 line cuts. 5 Rm.

THE COMMON COMMERCIAL TIMBERS of India and Their Uses—By H. Trotter, I.F.S., Forest Economist, Forest Research Institute, Dehra Dun. Calcutta: Government of India, Central Publication Branch. Cloth; 5¼x8¾ in.; pp. 153; halftones and line cuts. 3s.

BÉTON ARMÉ—Par Victor Forestier, Ingenieur-Constructeur (A. et M.), M. de la Société des Ingenieurs civils de France. Third Edition. Paris: Dunod, 92, Rue Bonaparte. Bound; 3¾x6 in.; pp. 428, illustrations and tables. 20.3 francs.

Particular attention is paid to safe construction in this, a combined handbook and yearbook on reinforced-concrete construction. The ten chapters treat in detail: mathematical formulas; bending moments and shear; French legal requirements for concrete design and construction; materials, planing and forms; design; buildings and industrial construction; bridges; retaining walls and dams; pipes, reservoirs and silos; hydraulic works.

HISTORY OF WAGES IN THE UNITED STATES from Colonial Times to 1928—Bull. 499, U. S. Bureau of Labor Statistics. Paper; 6x9 in.; pp. 527; many tables, mostly text up to 1840, with various interesting facts as to early customs and prices; chiefly tabular after 1840. 80c. from Superintendent of Documents, Washington, D. C.

THE MOHAVE DESERT REGION, CALIFORNIA: A Geographic, Geologic, and Hydrologic Reconnaissance—By David G. Thompson. Water-Supply Paper 578, U. S. Geological Survey. Paper; 6x9 in.; pp. 759; many folding maps, together with line cuts and halftones. $2 from Superintendent of Documents, Washington, D. C.

LAND VALUATION MAPS OF THE CITY OF DETROIT: Showing unit-foot land values for year of 1929 as adopted by the Board of Assessors and confirmed by the Board of Review—Detroit: Board of Assessors. Paper, cloth back; 17x15½ in.; 22 pp. of text, map of city and 78 sectional maps. $1.

Commended to the attention of those who are using either arbitrary non-systematic assessment methods or cumbersome attempts to be systematic. The brief text sets forth the standards used based on 1 ft. of frontage for mid-block lots 100 ft. deep, with percentage modifications for greater or lesser depths and for corner lots and methods of computing values of irregular-shaped lots. K. J. McCarren is engineer of the board of assessors.

PERMISSIBLE STORAGE-BATTERY LOCOMOTIVES and Power Trucks—By L. C. Ilsley, E. J. Gleim and H. B. Brunot. Bureau of Mines Bulletin 313. Paper; 6x9 in.; pp. 120; 49 illustrations. 45c. from Superintendent of Documents, Washington, D. C.

THE OHIO RIVER: Charts, Drawings and Description of Features Affecting Navigation; War Department Rules and Regulations for the River and Its Tributaries; Navigable Depths and Tables of Distances for Tributaries—Compiled under direction of the Chief of Engineering, U. S. Army, and the District Engineer, Cincinnati, Ohio—By R. R. Jones, Chief Assistant Engineer, United States Engineer Office, Cincinnati, Ohio. Fourth Edition. Revised to June 30, 1929. Cloth; 6x9 in.; pp. 333; line cuts, maps and tables. $1 from Superintendent of Documents, Washington, D. C.

PROGRESS TOWARDS LEGAL RECOGNITION of a Precise Inch Standard—By William E. Bullock. New York: American Institute of Weights and Measures, 33 Rector St. Paper; 7x10 in.; pp. 13.

PUNJAB ENGINEERING CONGRESS: Proceedings, 1929. A. N. M. Robertson, Honorary Secretary, P.W.D. Secretariat, Lahore, India. Paper; 5x9 in.; pp. 158; folding plates and other illustrations.

RUNOFF FORMULAS AND METHODS Applied to Selected Ohio Streams—By John C. Prior, Professor of Civil Engineering, Ohio State University. Engineering Experiment Station Bulletin No. 49. Columbus: Ohio State University. Paper; 6x9 in.; pp. 62; line cuts and tables 50c.

SEWAGE-TREATMENT PLANT at the Grand Canyon National Park—By H. B. Hommon, Sanitary Engineer, United States Public Health Service. Reprint from Public Health Reports, Oct. 5, 1928. Paper; 6x9 in.; pp. 16; illustrated. 5c. from Superintendent of Documents, Washington, D. C.

STRASSENBRUCKE KOLN-MULHEIM: 1927-1929—Berlin: Wilhelm Ernst & Sohn. Boards, cloth back and corners; 9½x13½ in.; pp. 125; line cuts, halftones and tables. 20 marks.

A STUDY OF RAINFALL IN TEXAS: Charts and Diagrams—Designed by B. F. Williams, State Reclamation Engineer, and prepared by Robert L. Lowry, Jr., Technical Assistant. Austin: State Reclamation Department. Paper; 9x12 in.; pp. 169.

Interesting and valuable maps and diagrams with a small amount of text. Takes up normal annual rainfall; variations from normal in monthly and annual, 1897 to 1926; five storms that caused great floods; greatest precipitation recorded; probabilities; intensity; hydrographs for Trinity and Brazos rivers; rainfall and runoff for three rivers. The normal and annual rainfalls are shown separately for western, central and eastern Texas, and records for some cities are given.

TRAVAUX PUBLICS—Par E. Aucamus, Ingenieur des Arts et Manufactures. Revise par Ph. Rousseau, Secretaire General de la Société francaise des Ingenieurs Coloniaux. A L'usage des Ingenieurs, Architects, Entrepreneurs, Conducteurs, Agents voyers, Metreurs et Commis de Travaux. Forty-ninth edition. Paris: Dunod, 92, Rue Bonaparte. Bound; 3¾x6 in.; pp. 580; illustrations and tables. 20¼ francs.

New features of this French yearbook on public-works constructions are sections on road resurfacing, recent improvements in surveying instruments and on waterproofing concrete. Other chapers treat of materials and of various public works, including canals, roads, ports and municipal works.

WASSERKRAFTANLAGEN—Von Dr. Ing. Felix Bundschu, in Düsseldorf. Vol. I—Allgemeines und Stauwerke. II—Werkwasserleitungen und Entwurfsgrundlagen. Berlin und Leipzig: Walter de Gruyter & Co. Cloth; 4x6 in.; 96 pp. in Vol. I, with 67 illustrations; 130 pp. in Vol. II, with 77 illustrations. 1.5 marks per volume.

The first volume describes the component parts of water-power plants; the second gives attention to the hydraulics and structural features of penstocks and canals, and also treats briefly mechanical appurtenances.

WATER-BORNE COMMERCE OF THE UNITED STATES for the Calendar Year 1928—Compiled in the office of the Board of Engineers for Rivers and Harbors. Extract from the Annual Report of the Chief of Engineers, 1929. Paper; 6x9 in.; pp. 1923; tables. From Superintendent of Documents, Washington, D. C.

WATER SOFTENING: The Base-Exchange or Zeolite Process, Summary of Existing Knowledge. Technical Paper No. 1, Water Pollution Research [British], Department of Scientific and Industrial Research. Paper; 6x9 in.; pp. 20. 6 pence from H. M. Stationery Office, London, England.

Letters to the Editor

Cost of Surface-Treated Macadam

Sir—In *Engineering News-Record* of Nov. 14, 1929, p. 776, in your digest of my paper read before the Asphalt Paving Conference at West Baden, Ind., you quote me to the effect that the cost of surface treatment of macadam consisting of a light oil prime coat and a coat of heavy oil was 90c. per square yard; that of two coats of heavy oil 94c.; that the cost of light oil road mix, 2½ in. thick, was $1 per square yard, and that the cost of multiple-lift bituminous macadam consisting of a 2½-in. compacted top over a 6½-in. compacted base was $1.18 per square yard.

No mention was made that these prices include the cost of the construction of a 9-in. compacted macadam, including both the base and the wearing course in question. This gives comformable conditions for each specification. One would infer from reading your digest of the proceedings that the cost per square yard included only the thickness of the oil mat alone, which would seem unreasonably high to your readers.

The costs were given on a square-yard basis for comparative purposes only. Actually the work is contracted for on a cubic-yard basis for stone and on a gallon basis for the bituminous binder.

R. H. Baldock,
Maintenance Engineer,
Salem, Ore., Oregon State Highway Commission.
Jan. 4, 1930.

Silt and Fertility

Sir—Referring to the article of E. McKenzie Taylor on "Agricultural Value of Nile Silt Held Fallacious" (*Engineering News-Record*, June 20, 1929), it seems apparent that we may have to give up our beliefs, which have held through the ages, that there is some relation between the long-sustained fertility of such lands as those of the delta of the Nile and periodical overflows with their contributions of silt. Such beliefs are tenacious, however, and one does not discard them without a feeling of regret or protest. It occurs to one to question if the conclusions drawn are not based on insufficient evidence and if there may not be factors contributing to the fertility of silted soils which the author has overlooked. The following examples are cited as having a possible bearing on the subject:

Five or six years ago I visited a sugar plantation on the Grijalba River in the State of Tabasco, Mexico, which the owner assured me contained one field which had been planted in cane by his grandfather 65 years previously and had been growing good crops of cane continuously since that time without replanting beyond the occasional "planting in" of a few seed stocks where there was a vacancy. I was later shown this particular field and noted that the vacant spaces in the rows of cane were quite infrequent and of only such extent that they could be filled by one or at the most two stocks of seed cane. Harvesting was just starting, and the appearance of the crop would indicate a yield of perhaps 40 tons of cane to the acre. To one familiar with cane culture, it seems that there must be some relation between this fertility and the frequent overflows of the river, which left a thin layer of silt on the lands. Extreme overflows doubtless would have been detrimental to the crops, but this plantation was at the point of the river where it was not flooded every year and the floodings that occurred were only a few inches in depth, the position being well up the alluvial plain, a considerable distance above the capital of the state, Villa Hermosa (old San Juan Bautista).

Another case, perhaps more to the point, is that of the lands overflowed by the Mississippi River, especially in the "lower delta" regions. Back of a crevasse there always was found a layer of sand a few inches to a few feet in depth. For several years after this new soil was placed it was worthless from an agricultural point of view, remaining

practically barren for the first year, gradually becoming seeded by a coarse grass and later by scrub willows. After ten or twelve years such lands are cleared of the willows, broken up and brought under cultivation, and are found to be exceptionally fertile. Owing to their fertility, coupled with the ease with which they can be cultivated as compared to the heavier gumbo and "buckshot" lands, they are much in demand.

A hundred years ago there were no lands under cultivation in the country which could compare in fertility with those of the lower delta, but during the last generation it has been found that even these may be depleted by too constant growth of one crop. Scientific agricultural methods have done much to restore these lands to profitable use, but experience has shown that there is a limit to the producing capacity of even delta soils.

The author of the article has indicated clearly that the immediate effect of the addition of a layer of silt is not beneficial to crops, and we may even accept his conclusion that it is detrimental; but it does not necessarily follow that without these annual or frequent additions the soil would retain its fertility indefinitely. Is is not possible that the weathering and gradual "ripening" of this new soil and its intimate mixture with older soils may be essential if the land is to produce crops year after year?

Hangchow, Chekiang, China, Sept. 25, 1929. ARTHUR M. SHAW.

Deflection Limits for Steel Beams

Sir—In discussing the allowable vertical deflection of steel beams under load the following statement is made in a widely distributed publication: "Live load deflection must not exceed 1/360 of the span." It is my understanding that it is fairly well established in practice that the deflection under *total load* shall not exceed the above-mentioned limit.

It is doubtless true that any deflection which might cause cracked ceilings would arise principally from the live load. However, it seems that a more general limit of rigidity is involved and that if this be properly observed, the possibility of cracked ceilings will be eliminated. It would also appear that if the deflections are to be based upon the live load alone a deflection allowance of 1/360 of the span is too large.

Port Huron, Mich., Jan. 5, 1930. BENJ. L. PARKER.

Hardening Retardant as Aid in Plastic Concrete Testing

Sir—We believe that the method for determining the composition and quality of concrete while in its plastic state, described by George S. Griesenauer in your issue of Nov. 28, 1929, p. 846, would be of greater value if the hardening of the concrete sample could be delayed until a convenient time for testing. Our experience indicates that the addition of sugar equal to 1 per cent of the weight of the cement will prevent any hardening of the concrete for four or five days. The use of sugar or other material as a retardant would make it possible to take a sample on any job and ship it to a testing laboratory for analysis by the "water method."

Boston, Mass., Jan. 6, 1930. MILES N. CLAIR, Vice-President, Thompson & Lichtner Company, Inc.

Stadium Designs

Sir—Since Mr. Serby, in his letter published in your issue of Dec. 5, 1929, p. 898, has injected into the discussion of the "typical stadium" illustration used in his article in the July 11, 1929, issue, p. 859, the entirely new and extraneous question as to whether or not Mr. Hunt's stadium design vitiates or violates my patent rights, I hope you will allow me a few words further in rebuttal. Mr. Serby states: "As this structure [the Pasadena stadium] was designed and completed before Mr. Hadden received his patent, it would follow that the idea of the crescent had been in use prior to his claiming date." I feel sure that it is only the plausible sound of this inaccurate statement which has enabled it to obtain the dignity of publication in your magazine. The conclusion stated of course does not by any manner of means "follow" Mr. Serby's premise, there being a matter of something more than six years between the date of filing and the date of issue of my patents.

New York City, Dec. 13, 1929. GAVIN HADDEN, Civil Engineer.

Vehicular Tube at Seattle

Sir—With reference to the news item in your issue of Dec. 26, p. 1024, in connection with the vehicular tube which we are proposing to build between Seward Park and Mercer Island, we wish to correct two of the statements made therein.

We have three alternatives for the crossing of Seward Park; depending on which alternative the park board finally decides to choose, we estimate the cost to vary from $3,600,000 to $4,000,000. This estimate of cost is based on a comparison with the Oakland Estuary tube, the cost of which was $4,500,000 for a total length of 4,500 ft., or about $1,000 per linear foot.

From the information available at the present time, in the form of soundings by the U. S. Coast and Geodetic Survey, the maximum depth of water at the site of the proposed tube is approximately 120 ft. (instead of 150 ft. as stated in your news item). The attached blueprint [not reproduced here—EDITOR] shows the fill which we propose to make in the still waters of the lake and the reinforced-concrete piles driven or jettied through the fill into the bottom of the lake, so that the diver work will be practically the same as if not easier than it was for the Oakland Estuary tube.

Seattle, Wash., Jan. 2, 1930. A. J. GILARDI, For Traffic Tube Construction Company.

Determining Stream Velocity by Air Bubbles

Sir—The principle of the method of determining stream velocity by air bubbles as developed by Otorogo Miyagi and described in *Engineering News-Record* for Dec. 12, 1929, was described under the caption "A New Current Meter" in *The American Engineer* of Feb. 18, 1882, by Luigi d'Auria. Professor d'Auria was delegated by the Italian government to take charge of its exhibit at the Centennial Exposition in Philadelphia in 1876, but instead of returning to Italy, he entered the service of the U. S. government and later of the water department of Philadelphia, under Col. William Ludlow, Corps of Engineers, where this method of measuring the mean velocity of a vertical element of a stream was worked out. (Professor d'Auria was also the inventor of the compensating device introduced in the d'Auria pumping engine, formerly in use by the Philadelphia and Atlantic City water departments.)

The apparatus consists of a pontoon or float anchored at the desired location, from one side of the upstream end of which a rod, secured in a vertical position, is lowered until entering the streambed. An endless cord passes around pulleys near the top and bottom of the rod, by which a ball, whose specific gravity is adjusted to half that of water, is carried to the bottom and released. The ball then rises with a uniform velocity and is caught at the surface by a floating grillage of wires stretched across a wooden frame, which is attached to the side of the downstream end of the float. The mean velocity is then found by dividing the distance from the vertical to the point reached by the ball by the time of its ascent as determined by a stop-watch.

By a rather elaborate computation and assuming the specific gravity of the ball one-half that of water, the time in seconds is shown to be $0.0314d + 0.058$, in which d is the vertical distance the ball travels. With $d = 30$ ft. and the velocity 4 ft. per second, the horizontal distance traveled would be about 44 ft., requiring a pontoon not over 60 ft. long.

The advantages claimed for this method over the current meter, especially in tidal streams, were its reliability, that it can be used by men of ordinary capacity and that it is less expensive.

New York City, Dec. 13, 1929. KENNETH ALLEN, Sanitary Engineer.

News of the Week

American Engineering Council Elects Grunsky President

Electing as its president for the coming year Carl E. Grunsky, of Stockton, Calif., past-president of the American Society of Civil Engineers, the American Engineering Council embarked upon a wide program of social service during 1930 at its annual meeting Jan. 10 and 11 in Washington. The keynote was sounded in a message from Mr. Grunsky in which he said that the engineer's attitude of aloofness toward public activities is changing and that he is learning to fulfill his duty as a citizen by letting his neighbor find out, through personal contact, that in most matters the engineer stands on the same plane as other citizens and desires to share with them the responsibility of solving civic problems. Too often in the past, said Mr. Grunsky, the engineer was apt to remain silent while the laymen among the Rotarians, Lions or Kiwanis discussed what should be done with garbage, the water supply or the local transportation system.

Vice-presidents elected for the ensuing year are L. B. Stillwell, G. S. Williams, L. P. Alford and O. H. Koch. H. E. Howe was re-elected treasurer. The board for 1930 is composed of C. O. Bickelhaupt, H. A. Kidder, R. F. Schuchardt, C. F. Scott, C. E. Skinner (American Institute of Electrical Engineers); H. S. Crocker, A. J. Dyer, Anson Marston, Frank M. Williams (American Society of Civil Engineers); Charles Piez, John Lyle Harrington, R. C. Marshall, Jr., E. N. Trump, John H. Lawrence, D. Robert Yarnall (Amercan Socety of Mechancal Engineers); H. E. Howe (American Institute of Chemical Engineers); Edwin F. Wendt (American Institute of Consulting Engineers); Prof. William Boss (American Society of Agricultural Engineers); Regional Districts: No. 1, George A. Reed; No. 2, B. A. Parks; No. 3, J. S. Dodds; No. 4, C. B. Hawley; No. 5, A. A. Krieger; No. 6, W. W. Horner.

Numerous recommendations concerning pending legislation were made by the council. Opposition was voted to the bill H. R. 5575, dealing with beach and shore erosion, on the ground that the work would not be of value to the general public but to local coastal interests. In response to a request from Representative Mapes for a suggested amendment to H. R. 733, concerning the Great Lakes-St. Lawrence waterway, the council voted to recommend an amendment providing that one-half of the engineers appointed by the President to the board shall be civilian engineers not in the employ of the federal government and that the other members shall be engineers equally qualified in federal engineering practice. The council indorsed President Hoover's recommendation concerning Muscle Shoals in principle and reaffirmed its opposition to all legislation that contemplates government ownership or operation or which sets aside the intent and purpose of the federal water-power act.

The council recorded its opposition to H. R. 1410, which provides for aiding farmers on wet lands in any state by making loans to drainage districts, levee districts and political subdivisions. A specal commttee will be apponted to consider all bridge bills.

Uniform Engineer Registration Law Meets Approval

Civil Engineers Board Adopts as Tentative New License Law Submitted to It

A TENTATIVE uniform registration law for engineers, submitted to the board of direction of the American Society of Civil Engineers by its committee on registration of engineers, was approved by the board at its meeting held in New York Jan. 13 and 14. The law has been prepared in co-operation with the National Council of State Boards of Engineering Examiners. The committee recommended that as registration is an accomplished fact the society urge and authorize its local sections to take an active part in local registration matters to the end that the best possible results be obtained.

The same committee recommended that the society depart from its traditional policy of not actively promoting the interests of civil engineers—that as a matter of public education it promote the publication in magazines and in the daily press of articles pointing out the duties and responsibilities of engineers.

The society's committee on technical procedure made numerous recommendations to the board looking toward improving the work of the divisions. These included provisions for continuity of the committee's personnel, limitation of the number of division meetings at the quarterly meetings of the society and improvements in the form of papers presented at such meetings. Solicitation of papers recording definite engineering accomplishments also is recommended by this committee.

A further recommendation tending to promote the interest of engineers was made by the committee on functional expansion. This committee proposes that the society's activities be divided into three departments—technical, administrative and professional, the latter to take an active part in promoting the advancement of the profession. This committee has prepared a complete program for the reorganization of the society's activities in which the field of each department and of each standing committee is outlined. Activities of departments are further subdivided into divisions or are delegated to committees.

The board authorized the setting up of a new committee on dams.

Recommendations made to the society by American Engineering Council on the subject of participation in the celebration of the 200th anniversary of the birth of George Washington was referred to a special committee for action.

Zoning Ordinance Adopted by Newark, N. J.

No limit is put on the height of buildings in the second business and the two industrial districts of Newark, N. J., in a zoning ordinance adopted by the city commission on Jan. 18, provided the "area of a building is reduced so that above a given level it covers not more than 25 per cent of the area of the lot" and provided also that the high part of the building "sets back from each of its lot lines at every level at least 1 in. for each 1 ft. that such level is above the curb level."

The ordinance provides three residence, two business and two industrial zones, with fixed heights of buildings, percentage of lot area that may be built upon, widths of side and depths of front and rear yards, dimensions of inner and outer courts and population densities for each zone, with exceptions for some of the zones. Heights in first and second residence districts may not exceed 2½ stories, while in third residence districts they may not exceed twice the width of the widest streets on which they front, but no street shall be considered as more than 60 ft. wide. Population densities are set at 2,000 sq.ft. of lot area per family; 1,200 sq.ft. in second residence districts, and 1,000 sq.ft. for each story in third residence districts.

Heavy Rains Relieve Power Situation

Several days of heavy rainfall have relieved the critical power situation in British Columbia. W. G. Murrin, president of the British Columbia Electric Railway Company, has announced that at the end of December the lakes had risen sufficiently to warrant the conclusion that the most critical period had passed and that with ordinary runoff from the watersheds full normal load of the company could be carried. Lake Coquitlam has risen 23 ft. since the time in November when it reached its lowest level. Other lakes in the British Columbia lower mainland has risen proportionately.

Am.Soc.C.E. at Annual Meeting Awards Prizes and Medals

RECIPIENTS of a number of annual awards made by the American Society of Civil Engineers were honored at the Jan. 15 session of the annual meeting in New York City. The awards were made this year on the basis of papers appearing in *Transactions*, Vol. 92 (December, 1928). Prize winners are as follows:

Norman Medal

Commander GILBERT THOMAS RUDE, U. S. Coast and Geodetic Survey, received the Norman medal for his paper, "Tides and Their Engineering Aspects. Commander Rude was born in Sharps, Va., and received his education at Washington College, Chestertown, Md. He entered the U. S. Coast and Geodetic Survey in 1903 as deck officer and has been with that service ever since, with the exception of a period from September, 1917, to March, 1929, during which period he was with the U. S. Naval Reserve forces. In July, 1919, he was appointed chief of the section of tides and currents at Washington.

G. T. RUDE

Thomas Fitch Rowland Prize

D. B. STEINMAN and WILLIAM G. GROVE were awarded the Thomas Fitch Rowland prize for a joint paper, "The Eyebar Cable Suspension Bridge at Florianopolis, Brazil." In the award of this prize, preference is given to papers describing accomplished work of construction, its cost and design and execution.

D. B. STEINMAN

Mr. Steinman is a native of New York City and a graduate of Columbia University. After several years of miscellaneous surveying and designing work on elevated and subway structures and the water supply for New York City, he became, in 1910, associated with the civil engineering department of the University of Idaho. In 1914 he became principal assistant to Gustav Lindenthal, working with him on the design of a number of important bridges, including the Hell Gate arch bridge over the East River, and the Sciotoville bridge over the Ohio River. Beginning in September, 1917, Mr. Steinman was for three years professor in charge of civil and mechanical engineering at the College of the City of New York. In 1921 he opened an office as consulting engineer and shortly thereafter became associated with his present partner, Holton T. Robinson. Besides the structures already named, Mr. Steinman has been concerned with the design and construction of a number of notable bridges in many parts of the world, including the Rondout suspension bridge at Kingston, N. Y., the Detroit-Windsor suspension bridge, the Steubenville suspension bridge over the Ohio River, the Carquinez cantilever bridge in California, the Sydney harbor bridge in Australia, the Mount Hope syspension bridge in Rhode Island, the Grand'Mere bridge in Quebec and the St. Johns bridge at Portland, Ore. He has also prepared plans for the proposed bridge across the Narrows at New York City. Mr. Steinman has published a number of books on bridge design and was awarded the Norman medal by the American Society of Civil Engineers in 1924 for a paper "Locomotive Loadings for Railway Bridges."

William G. Grove, associated with Robinson & Steinman, was born in Philadelphia, Pa., and was graduated from the University of Pennsylvania in 1909. He started work while still in his teens as an apprentice at the Pencoyd plant of the American Bridge Company, with which he remained five years before taking up his studies at the University of Pennsylvania. Following his graduation in 1909, he returned to the American Bridge Company as a designer in the New York office.

W. G. GROVE

James Laurie Prize

R. H. KEAYS, chief engineer for Ulen & Company, was awarded the James Laurie prize for his paper, "Construction Methods on the Moffat Tunnel." Mr. Keays was born in Sarnia, Canada. He received a civil engineering degree from Cornell University in 1895 and after about four months experience as topographer with the Adirondack State Survey returned to that institution as instructor and graduate student. In 1897 he became assistant engineer for the Public Improvement Commission of Cohoes, N. Y., working on sewer design. The following year he was recorder with the U. S. Deep Waterways Survey, leaving to enter the army during the Spanish-American War. Then followed three years of surveying for the Water Department of Havana, Cuba, and one year of New York City subway work. In 1903 Mr. Keays became resident engineer for the Illinois Central Railroad, working on surveys for improvements of the Cairo bridge, but left shortly after to become assistant engineer of surveys for the Hudson tube in New York City. He remained on this job for three years, and then became office engineer and, later, assistant engineer, on the Wallkill tunnel and the Shandaken tunnel of the New York City water-supply system. From 1914 to 1919 he was chief engineer for the New York & New Jersey Construction Company in charge of construction of a portion of the Passaic Valley sewer. In 1920 he returned to the Shandaken tunnel as assistant general superintendent for the Ulen Construction Corporation. From 1923 to 1925 he was chief engineer for the Moffat Tunnel Commission at Denver, Col. At present he is in Athens, Greece, for the Ulen Construction Corporation.

R. H. KEAYS

Arthur M. Wellington Prize

FREDERICK C. CARSTARPHEN, consulting engineer for the Pittsburgh Coal Company, was awarded the Arthur Wellington prize for his paper, "Aerial Tramways." This prize was instituted and endowed by *Engineering News-Record* in 1921 and is restricted to papers on transportation. Mr. Carstarphen, who was born in Denver, Col., attended the Colorado School of Mines. Before graduation he was engineer of construction of the Golden gravity water-works system, which included 13 miles of wood-stave pipe and five storage reservoirs. After leaving college he became a U. S. deputy surveyor, working on the re-establishment of a portion of the line between Colorado and Wyoming. Two years later he became engineer for the Colorado Portland Cement Company and directed the erection of the first ten-story reinforced concrete structure in Denver. In 1920 he was appointed U. S. mineral surveyor, but soon became manager of the Vulcan Sulphur Company. After three years of miscellaneous mining work Mr. Carstarphen became aerial tramway engineer for the American Steel & Wire Company, which position he retained for ten years, directing the design and erection of several hundred aerial tramways of various sizes and types. During this time, while stationed at Trenton, N. J., he became chairman of the zoning commission of that city, and consulting engineer for the State of New Jersey, Mercer County, the city of Trenton and others. In 1925 he was elected vice-president of the New Jersey Society of Professional Engineers and Land Surveyors. Returning to Denver in 1926, he became consulting engineer for the Pittsburgh Coal Company, employed in the design and erection of aerial tramways. Mr. Carstarphen is a member of the American Society of Civil Engineers and of the American Institute of Mining and Metallurgical

F. C. CARSTARPHEN

Engineers and has lectured at a number of universities, including Columbia, Massachusetts Institute of Technology and the University of Colorado.

Collingwood Prize

WILLIAM J. COX, assistant professor of engineering mechanics in the Sheffield Scientific School, Yale University, received the Collingwood prize for his paper, "Automobile Hazard in Cities and Its Reduction." Professor Cox was born in Portland, Ore., and was educated in the public schools of Lexington, Va., and at Washington and Lee University. He left college for the army, serving as second lieutenant with the 605th Engineers, A.E.F. Upon his discharge from the service he entered the employ of H. E. Fox, civil and mining engineer, at Big Stone Gap, Va., leaving to become instructor in engineering mechanics at Yale University.

W. J. COX

Rivers in Mississippi Valley at Flood Stage

Heavy rains in the past week have raised the rivers in the lower Mississippi Valley to flood stage, and towns and land in Arkansas, Mississippi, Tennessee and Kentucky are inundated. There is no suffering, but several hundred families have been greatly inconvenienced. The chief cause for worry at present is the fear of a high stage of the Mississippi itself, and its effect in blocking the flows of the tributaries.

Damage to streets, highways and bridges in Memphis, Tenn., has been estimated at $200,000. The schedules of the railroads connecting with Memphis have been affected and many of the trains are being detoured in order to avoid the flooded region. In the vicinity of Henderson, Ky., the Ohio River has reached a height of 3.2 ft. above flood stage, and several rural schools in the vicinity have been closed because of water flooding the roads. Families living in the low-lying sections where the Green River flows into the Ohio have left their homes and sought higher ground.

New York Firm Gets Contract for $2,000,000 Dam in Chile

A contract for the construction of the Junta del Carmen irrigation dam, to cost $2,000,000, in the Ovalle district of Chile has been signed by the Chilean government and Ulen & Company, construction engineers, of New York. This dam, which is part of Chile's extensive irrigation program, is a new project, but is the third to be built by the contractors in Chile.

J. F. Coleman Elected President of Am.Soc.C.E.

At the business session of the annual meeting, American Society of Civil Engineers, held Jan. 15 in New York City, John Francis Coleman, consulting engineer, of New Orleans, La., was elected president of the society. Other officers chosen at the same session include the following: vice-presidents, Frank E. Winsor, chief engineer of the Metropolitan District Water Supply Commission of Massachusetts, and Joseph M. Howe, contractor, Houston, Tex.; directors, Ole Singstad, chief engineer of the Holland tunnel; John R. Slattery, deputy chief engineer, New York City Board of Transportation; Charles H. Stevens, consulting engineer

J. F. COLEMAN

and engineer of design for the Philadelphia subways; Franklin Thomas, professor of civil engineering, California Institute of Technology; D. A. MacCrea, consulting engineer, Little Rock, Ark.; and Allan D. Dusenbury, consulting engineer, New Orleans, La.

Mr. Coleman, born in 1866 in Jefferson County, Miss., and educated in the public schools of New Orleans, began his engineering work in 1884 as rodman on preliminary and location surveys for a railroad in Guatemala, Central America. For some years thereafter he was continuously engaged in railroad engineering work with the Kansas City, Memphis & Birmingham Railroad, the Texas & Pacific Railway Company and the New Orleans & Western Railroad, now the New Orleans Terminal Company. In 1896 he was appointed principal assistant city engineer of New Orleans, resigning in 1900 to open an office as consulting engineer. He practices in a number of fields, including railway work, land reclamation and drainage, water-works, foundations, structural designs, river hydraulics, shipyard construction, and harbor and port development. Mr. Coleman became a member of the American Society of Civil Engineers in 1901, was a director in 1915-17 and vice-president 1918-19. He has served as a member of several committees of the society, including the one which framed the present constitution and bylaws and the committee on Mississippi River flood control. He was the organizer of the Louisiana Engineering Society and is a past-president and an honorary member; also a past-president and member of the American Institute of Consulting Engineers and a member of the American Railway Engineering Association. In New Orleans, he is a member of the City Planning and Zoning Commission.

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RALPH MODJESKI

At this session the John Fritz gold medal was officially presented to Ralph Modjeski in appreciation of his distinguished scientific and industrial achievements as one of America's foremost bridge builders. The award of the medal was made Sept. 27, 1929, and announced in *Engineering News-Record*, Oct. 3, 1929, p. 546.

Central Highway Approaches Completion in Cuba

All the grading and about half the paving has been completed on the new Cuban Central Highway, a 700-mile project traversing the entire length of the island. The new highway project was described in *Engineering News-Record*, issue of April 7, 1927, p. 558.

On the 110-mile section between the cities of Havana and Pinar del Rio, 93 miles of paving has been laid. The Department of Public Works promises completion by May 20, 1930. In the Province of Matanzas, paving has been completed to a point 93 miles east of Havana, leaving uncompleted only that portion between Perico and the eastern boundary of the province. Only 44 per cent of the highway in the Province of Santa Clara is paved and ready for use, but in the adjoining Province of Camaquey construction is 73 per cent finished, and it is promised that the entire length of the 152 miles of the highway in that province will be ready for use by June 30, 1930. In the Province of Oriente, in which Santiago de Cuba, the eastern terminus of the highway, is located, 42 per cent of the road was ready for use in November, 1929.

When the highway is completed it is planned to line the entire road on each side with royal palms set about 40 ft. apart.

New Council Ousts City Manager

William R. Hopkins, who has been city manager of Cleveland since the city adopted that plan of government in 1924, was removed from office on Jan. 12 by the new city council. The ouster motion was carried by a vote of 14 to 11 and followed a debate that lasted nearly three hours.

Pasadena to Buy Electric Plant of S. C. Edison Company

With the approval of the California railroad commission, the city of Pasadena, Calif., and the Southern California Edison Company have arrived at an agreement whereby the municipality has taken a two-year purchase option at $783,000 on the company's holdings in Pine Canyon, including the Azusa electric plant, 1,000 acres of land and all rights in the canyon.

Under the terms of the agreement, all power produced at the 1,500-kw. Azusa plant, after acquisition by the city, will be turned over to the company at the plant and then transmitted over the company's lines to Pasadena, and the city is to be permitted to draw at any time during the year the total amount of power produced in any year. The city is to pay transmission charge to the Edison company of $0.002 per kilowatt-hour, a rate which entitles it to take power during peak loads if it desires.

Pine Canyon dam site lies wholly on Edison company lands, and through the agreement described the city is enabled to proceed immediately with further testing of the the site. The exploration work will be a part of the city's water development project in Pine Canyon, where it plans to obtain additional domestic water supply by erecting a high dam and impounding excess floodwater.

Contractors Ordered to Stop Work for Annexed Borough

Contractors engaged in construction work contracted for by Overbrook borough, Pa., before it had been annexed to Pittsburgh on Jan. 6 have been ordered to hold up their work by the Pittsburgh authorities. The city solicitor and city controller, who issued the order, have been engaged in investigating the financial condition the borough had just previous to its annexation.

The investigation so far indicates that in the last few months of its existence as an independent borough Overbrook had authorized construction work totaling about $800,000, approximately $500,000 more than the borough's legal bonding power allowed. The contractors have been ordered to stop construction work, or to proceed at their own financial risk, until it can be learned whether the borough was qualified financially to contract for all the street and sewer work its council had ordered.

City of Wheeling Ordered to Install Water Meters

Installation of water meters for all consumers served by the municipal water plant of Wheeling, W. Va., at a rate corresponding to an expenditure of $60,000 a year, is required by an order of the Public Service Commission of West Virginia. The city applied to the commission for authority to change water rates, which are fixed by the commission's order. At the same time the city asked to be excused from complying with a rule adopted by the commission that "all water sold within the State of West Virginia shall be by meter measurement." No sufficient reason was shown by the applicant, the commission says, and the city is ordered to begin the installation of meters and to proceed with diligence.

Preliminary Plans for Second N. Y. Vehicular Tunnel

Engineering studies have been made and a plan has been prepared by the New York State Bridge and Tunnel Commission and the New Jersey Holland Tunnel Commission for the proposed Weehawken-38th Street tunnel. The commissions, having completed their preliminary work, are now ready, immediately upon authorization by the two states, to proceed with test borings and the preparation of detailed contract plans.

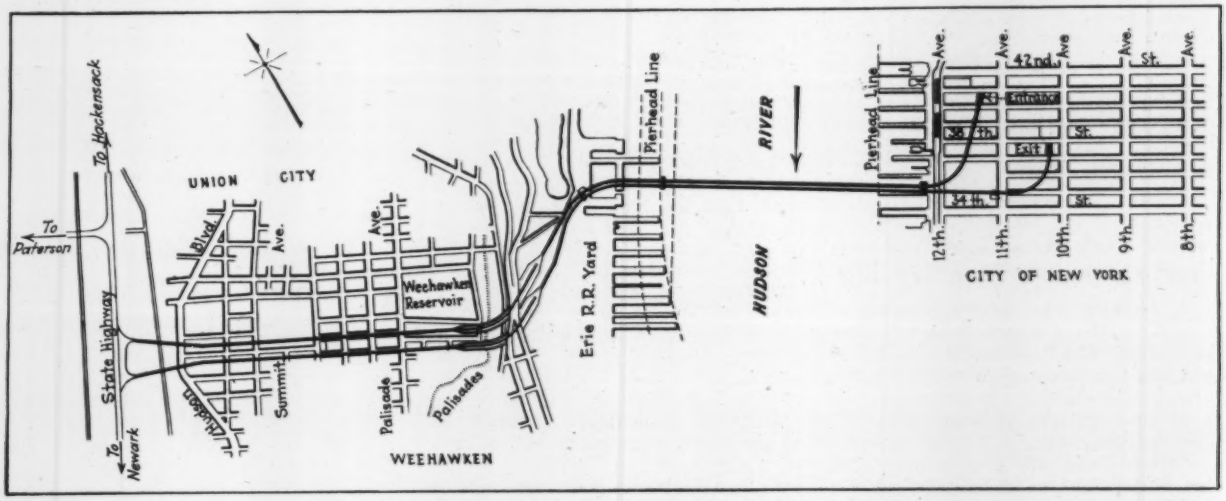
This second step in the program of construction of interstate highway crossings between the Borough of Manhattan and the State of New Jersey consists of twin tunnel tubes with traffic facilities similar to those now in use in the Holland tunnel. The location of the New York plaza shown on the plan is subject to modifications to be worked out in co-operation with the city of New York so as to provide the most direct means of access, either on the surface or underground or both, with the 38th St. crosstown tunnel authorized by the city of New York, which is to extend from Tenth Ave. easterly under 38th St. The tunnel will also afford easy access to the elevated express highway along Twelfth Ave., now under construction by the city of New York.

The proposed tunnel through Bergen Hill, a long ridge running along the west bank of the Hudson River, will really be a part of the proposed Weehawken-Midtown tunnel, as it will serve in the nature of the main approach through which the largest part of the traffic will seek this river crossing. A preliminary estimate of cost of the proposed tunnel, including the Bergen Hill tunnel, indicates the amount to be approximately $62,000,000.

The proposed location of the Weehawken - Midtown tunnel is at the center of density of the ferry traffic crossing the Hudson between Manhattan and New Jersey. It is expected that the Hudson River bridge at 178th St. will be opened to traffic in 1932. This will take care of the Hudson River traffic in the extreme uptown part of Manhattan and will have no effect on traffic crossing the Hudson River south of Central Park.

The Holland tunnel has been in operation for two years and the traffic during the second year showed an increase of about 26½ per cent over that of the first year. On the basis of an increase of only 15 per cent per year for the next two years, the Holland tunnel will reach its traffic capacity by the spring of 1932.

It is estimated that during the first year of operation the Weehawken-Midtown tunnel will carry more than 9,000,000 vehicles, which is slightly greater than the traffic carried by the Holland tunnel during its first year.



PROPOSED ROUTE FOR WEEHAWKEN-MIDTOWN TUNNEL

WASHINGTON NOTES

By Paul Wooton

Labor Restrictions on Federal Work—National Employment Offices — River Development

ATTEMPTS that have been made during the past years to restrict the employment of labor on federal building projects to the communities in which the building work is being done are being renewed in the present session of Congress. A bill has been introduced by Representative Bacon, of New York, to require contractors and sub-contractors engaged in public works of the national government to give certain preferences in the employment of labor. Some of the Senators from Mid-Western states are known to be contemplating the introduction of similar measures. Under the terms of the Bacon bill contractors engaged in public works would be compelled to give preference in the employment of labor in the following order: to citizens of the United States and of the state or district in which the work is to be performed, who have been honorably discharged from military service; to citizens of the United States who are bona fide residents of the state or district in which the work is to be performed; and to citzens of the United States.

Those interested in the construction industry regard this measure as another attempt to enact general legislation to remedy a particular situation. In several cases contractors from remote sections have gone into highly competitive fields and have taken public-works contracts away from local concerns that have to meet more rigid regulation. It is believed, however, that the contractors can meet the situation through their own agencies and render unnecessary further restrictive legislation.

National Hydraulic Laboratory

In order to make provision for fundamental research work pertaining to flood control and other engineering activities dealing with hydraulics, a bill has been introduced by Senator Ransdell authorizing the establishment of a national hydraulic laboratory at the Bureau of Standards in Washington. Similar bills have been introduced in past sessions of Congress but have failed to receive the sanction of the rivers and harbors committee of the House. During the last regular session of Congress the Senate acted upon this legislation and passed a national hydraulic laboratory bill.

A degree of opposition from the Corps of Engineers was manifested against the hydraulic laboratory bill on former occasions. It is believed, however, that the opposition will not be renewed by the present Chief of Engineers. President Hoover favors the legislation.

Waterway Projects

An appropriation of $5,000,000 for improving the Arkansas River for navigation by providing a 9-ft. channel from Little Rock to the point where the river flows into the Mississippi is proposed in a bill introduced by Representative Ragon and referred to the House committee on rivers and harbors.

Whether or not the Lakes-to-the-Gulf waterway project will be taken over by the federal government and rushed to early completion will depend to a large extent on a report on the undertaking that is being transmitted to the House rivers and harbors committee by the War Department. This report was drafted by the district engineer of the War Department at Chicago. It already has been approved by the rivers and harbors board of the Corps of Engineers and by the Chief of Engineers.

According to congressional policy in such matters, the contents of the report cannot be divulged until it has been turned over to the committee of the House or Senate that asked for it. Members of the House who are interested in the waterway, however, believe that the recommendations of the engineers will be favorable to the nationalization of the project. They base this opinion on discussions that they have had with engineer officers. Under the present plan the federal government has committed itself to the completion of the waterway between the mouth of the Illinois River and Utica. For this portion of the project an expenditure of $3,500,000 has been authorized. The remaining part of the work is at present under the charge of the State of Illinois. To complete the section of the waterway between Utica and Chicago, the state some time ago raised $20,000,000 through the means of a bond issue. This amount has become exhausted owing to a number of unforeseen expenses that have been occasioned, the largest of which was brought about by a court decision requiring the state to pay for the relocation of railroad bridges. As it is realized that it would be difficult for the local authorities to obtain legislative sanction for further financing, it is proposed that the federal government take over and complete the section of the waterway that the state has undertaken to construct. It is for this reason that the army engineers have prepared the report on the state's portion of the waterway, stating just how much work remains to be done, its probable cost, and whether or not the situation justifies intercession by the federal government.

The Business Outlook

While trade sentiment is good and the output of optimism continues high, it is too early as yet to see much concrete evidence of improvement. The next two or three weeks must pass before it will be possible to gage the period and strength of revival. Money, banking and security market conditions are still doubtful. If allowance is made for the effect of holiday shutdowns during the two preceding weeks, steel-mill operations during the first complete week of the year showed no improvement, despite the impressions given by the trade reports. For the industry as a whole operations were at slightly below 60 per cent of capacity, as against the comparable figure of 62 per cent for the preceding week and 84 per cent a year ago. There is as yet no definite sign of increase in automotive demand, pending the results of the automobile shows.

—*The Business Week*, Jan. 15.

National Employment Offices Proposed

Establishment of a national system of public employment offices is proposed in bills introduced in Congress by Senator Wagner, of New York, and Representative Cable, of Ohio. The object of the bills is to establish and maintain a system for clearing labor among the several states, and for this purpose a new bureau known as the United States employment service would be created in the Department of Labor. The declaration is made in the Wagner bill that the service conducted shall be impartial, neutral in labor disputes and free from political influence. An annual appropriation of $4,000,000 for a period of ten years is proposed in the Wagner bill, 75 per cent of which would be apportioned among the states in proportion to their population, contingent upon state appropriation of an equal amount.

To Stabilize Employment

Stabilization of employment by utilizing public construction work is the object of another bill introduced by Senator Wagner proposing creation of a board of four Cabinet officers to carry forward long-range planning for construction of public works so that such construction could be accelerated in periods of depression without delay in preparation. The plan also contemplates co-operation with the states in planning public-works construction for the purpose of distributing work evenly throughout the year. Expansion of the work of the bureau of labor statistics is proposed in a third bill introduced by Senator Wagner with a view to preventing unemployment by providing more complete statistics and more comprehensive information concerning unemployment and its causes.

Airways

Included in the army appropriation bill is an item of $2,724,073 to provide for technical construction contemplated by the Army Air Corps for 1931. The construction will include the installation or expansion of facilities at fields throughout the United States, Hawaii and the Canal Zone. Construction at Langley Field, amounting to $895,590, is the largest project covered by the appropriation bill.

Personal Notes

J. WILLIAM GRIFFIN, of Kearny, N. J., has been appointed superintendent of the Wanaque reservoir.

HARRY F. ANDREWS has been reappointed commissioner and city engineer of Slocum, N. Y.

WILLIAM CHAMBERLAIN has been elected a director of International Paper & Power Company.

JOSEPH W. OBRIETER, civil engineer and architect, of Bloomfield, N. J., has been elected town engineer, succeeding Francis B. Dwyer.

JOHN J. JESSUP, formerly city engineer of Whittier, Calif., has been made city engineer of Los Angeles to succeed John C. Shaw.

E. B. BUSHNELL, formerly connected with the Portland Cement Association, is now associated with the Masonite Corporation of Chicago.

HAROLD C. FISKE, lieutenant-colonel, Corps of Engineers, now stationed at Fort Lawton, Seattle, Wash., will go on the retired list of the army on his own application on June 15.

EDWARD P. WARNER, editor of *Aviation* and formerly Assistant Secretary of the Navy for Aeronautics, has been elected president of the Society of Automotive Engineers.

B. J. HEAD was appointed road engineer for Davies County, Ky., on Jan. 7. His appointment is to fill the unexpired term of J. W. Spurrier, who resigned in January.

VINSON B. SMITH, of Gulfport, Miss., has been elected president of the Mississippi Architectural Examining Board. R. C. SPRINGER, of Meridian, was named secretary.

RICHARD B. CARR, manager of the heavy products department, U. S. Steel Products Company, San Francisco, Calif., has resigned from that position and has announced his intention of retiring from business activities.

HUBERT E. SARGENT, who has been acting in that capacity for several months, has been appointed highway commissioner of the State of Vermont. He will also continue to occupy the position of chief engineer.

DANIEL MCFARLAND, of Azusa, Calif., who has been making an investigation and report on the hydroelectric resources of the Plateau Province of Nigeria for the Yuba Associated Engineers for the past fifteen months, has finished this work and returned to California.

E. F. HARPER, chief engineer of the East Side Levee Sanitary District, with offices in the Metropolitan Building, East St. Louis, Ill., was re-elected to that position at the organization of the new board of trustees for the district at East St. Louis on Jan. 8.

J. FRANKLIN BELL, lieutenant-colonel, Corps of Engineers, formerly engineer commissioner of the District of Columbia, was placed on the retired list of the army on his own application on Jan. 6, and has assumed his new civic duties as city manager of Covington, Ky.

LOUIS T. GOLDING, retired newspaper publisher of St. Joseph, Mo., has been appointed a member of the state highway commission for a six-year term expiring on Dec. 1, 1935. He succeeds E. J. McCrew, of Lexington, Mo. Mr. Golding formerly published the St. Joseph *News Press* and the St. Joseph *Gazette*.

ALBERT T. CONNAR, of Zanesville, Ohio, has been appointed by Governor Cooper as director of public works to succeed Richard T. Wisda, whose term expired Jan. 2. Mr. Connar has been a county commissioner of Muskingum County and previously was county engineer of the same county.

W. R. HOLWAY, consulting engineer, New York, has opened a branch office in Tulsa, Okla., where he has been retained to make a report on the future water supply of Tulsa and to design and construct such work as is necessary during the next four or five years. Mr. Holway recently returned from Russia, where he went to make a report on the new water supply of Moscow, being retained by New York financial interests.

RICHMOND H. SKINNER, of Boston, Mass., has joined the engineering staff of the National Lumber Manufacturers Association as structural engineer, succeeding Nelson S. Perkins, who recently resigned to accept a position with the National Committee on Wood Utilization. Mr. Skinner was graduated from the California Institute of Technology in 1923 and since that time has had a varied technical experience.

Society Calendar

AMERICAN CONCRETE INSTITUTE, Detroit; annual convention, New Orleans, La., Feb. 11-13.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; annual meeting, Chicago, Ill., March 11-13.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago; annual meeting, Seattle, Wash., Jan. 28-30.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington; annual convention, New Orleans, La., Jan. 20-22.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Trenton; annual convention, Syracuse, N. Y., Feb. 19-21.

ENGINEERING INSTITUTE OF CANADA, Montreal; annual convention, Ottawa, Ont., Feb. 12-14.

NATIONAL CRUSHED STONE ASSOCIATION, Washington; annual convention, Cincinnati, Ohio, Jan. 20-23.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington; annual meeting, Memphis, Tenn., Jan. 28-30.

ILLINOIS SOCIETY OF ENGINEERS will hold its 45th annual convention Jan. 22-24 at East St. Louis. Seven technical sections will meet. W. D. Gerber, Urbana, is acting secretary.

NEW YORK STATE SEWERAGE WORKS ASSOCIATION will meet Jan. 18 in New York City.

NORTH CAROLINA ENGINEERS will meet in Raleigh Jan. 24-25 under the auspices of the North Carolina Society of Engineers, the North Carolina section of the American Society of Engineers and the Raleigh branch of the American Society of Mechanical Engineers.

TEXAS WATER WORKS SHORT SCHOOL for water and sewer plant operators will be held Jan. 27-30 at Abilene, Tex.

Obituary

BOYD F. WALKER, city engineer of Council Bluffs, Iowa, died recently of anemia. Mr. Walker was graduated from the Iowa State College and had been engaged in engineering work at Council Bluffs for fourteen years.

JOHN J. SCOLLAN, retired construction engineer, died at his home in Los Angeles, Calif., of heart disease on Jan. 6, at the age of 60.

MINER H. VALLAS, professor in the college of engineering, Tulane University, New Orleans, died in that city during the first week in January. Mr. Vallas had been a member of the Tulane faculty for the last eight years.

ERNEST G. HOLLADAY, head of the E. G. Holladay Construction Company, of Nashville, Tenn., died at his home at the age of 53 years. Mr. Holladay was graduated from Purdue University in 1901.

WILLIAM C. TAYLOR, construction engineer for the Grant-Smith Construction Company, of Portland, Ore. died at his home in Camas, Wash. Mr. Taylor was graduated from Purdue University in 1897 and from that time until 1918 was connected with railroad companies in the Northwest as division and construction engineer.

R. W. STODDARD, dean of the school of engineering of the New Mexico Agricultural and Mechanical College, was accidentally electrocuted on Dec. 31 while working in the college radio station. He was alone in the dynamo room at the time of his fatal accident and little is known of the exact details. Dean Stoddard went to the New Mexico college in 1914 as head of the department of electrical engineering and had been dean of the engineering school for the last nine years.

CHARLES H. SEMPER, a civil engineer with the U. S. Bureau of Public Roads, died at Mercy Hospital, Watertown, N. Y., on Jan. 7, aged 58, after a long illness. Mr. Semper was a widely known engineer and during his service with the federal government had traveled extensively and was at one time located in Porto Rico. He joined the government service in 1892.

JOHN R. BENTON, dean of the college of engineering at the University of Florida, died at his home in Gainesville on Jan. 8. He was 53 years old. Dean Benton was a graduate of Trinity University and the University of Chicago, also of the universities of Göttingen and Berlin, in Germany. He had been a member of the University of Florida faculty for 25 years, and head of the engineering college for nineteen years. He was the author of a number of books on engineering subjects, the most recent one of which was "An Introductory Textbook on Electrical Engineering." He was a past-president of the Florida Engineering Society and, when he died, was its secretary.

Construction Equipment and Materials

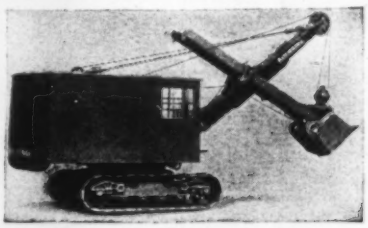
New Lead Alloy Discovered

Announcement has been made by the British Non-Ferrous Metals Research Association of the discovery of a new ternary-lead alloy suitable for use in waterpipes and sheets which possesses many advantages over pure lead, including lighter weight, 84 per cent greater tensile strength, 217 per cent greater resistance to vibration and more resistance to certain corrosive waters. This alloy was discovered during investigation into the cause of breakdowns in lead cable sheathings. It consists of 98.25 per cent lead, 1.5 per cent tin and 0.25 per cent cadmium.

New Developments

Anti-Friction Bearings and Inclosed Gears in New Shovel

Several improvements in design feature a new 1-cu.yd. shovel-pull shovel-crane-dragline known as model 401, recently developed by the Koehring division of the National Equipment Corporation, Milwaukee, Wis. All gears except the turntable gear and swing pinion are inclosed and run in oil. All machinery shafts which enter into the operations of hoisting, drag, dipper crowd, boom hoist and swing are mounted on roller or ball type anti-friction bearings. Variations in speed are provided for by a gear shift which gives hoist line speeds of 205 and



1-CU.YD. EXCAVATOR RIGGED AS SHOVEL

162 ft. per minute, suitable for either two- or three-part cable reeve. For rock work, still slower speeds may be had through the use of a different diameter for the drum barrel. In other respects the new model follows the usual practice in Koering machines, utilizing the independent cable crowd, the shovel boom shock absorber, double outside band self-equalizing friction clutches, accident-proof traction lock, and positive steering arrangement from the cab. Power is supplied by a six-cylinder Koehring-Wisconsin gasoline engine which develops 100 hp. at 1,075 r.p.m. Bore is 5¼ in., stroke 6½ in. When built as a shovel the new Koehring handles a 1-cu.yd. dipper on 16-ft. dipper sticks. Equipped for crane work, it has a capacity of 13 tons at a radius of 12 ft., with 50 per cent safety factor.

All-Purpose Tractor Has Built-In Hoist

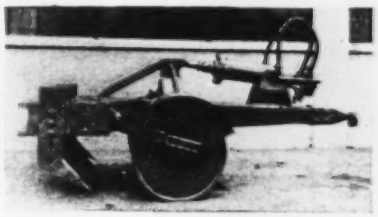
Accessories for all kinds of construction work are available for use with a new crawler-type tractor with built-in two-drum hoist designed by the Scott Engineering Company, Charleston, W. Va. Power is supplied by a 25-hp. six-cylinder Continental motor. A feature of the machine is its method of

TRACTOR WITH SIX-CYLINDER MOTOR

steering, which permits the reversal of direction of either track at the will of the operator. This makes it possible to pivot the machine on its own center, a very useful feature when operated as a crane. Equipment includes electric starting and lighting, special oil-type air cleaner, built-in two-drum hoist and double power take-off. The tractor frame is drilled for the installation of additional equipment, such as crane boom or shovel attachment. Two crane sizes are available, one handling loads up to 1,500 lb. and the other up to 3,500 lb. on a boom swing of 14 ft. In the construction of the tractor the welding process is used to a considerable extent.

Hydraulic Cylinder Regulates Height of Scarifier

Regulation of the height of a scarifier by the operator of the tractor drawing the machine is provided for in the design of a new piece of equipment produced by the American Tractor Equipment Company, Oakland, Calif., known as the Ateco hydraulic scarifier. The main frame of this machine, made of solid cast steel, carries five tooth standards placed 12 in. apart and provided with reversible steel points. The width over all is 63 in., the end teeth cutting outside of the road wheels. The scarifier will cut to a maximum depth of 20 in. Depth of cut is regulated by means of a 7-in. cylinder carying a piston connected by a toggle mechanism with the scarifier casting. The position of the piston, regulated by the tractor operator by means of a three-way valve connected to an oil pump, determines the angle be-

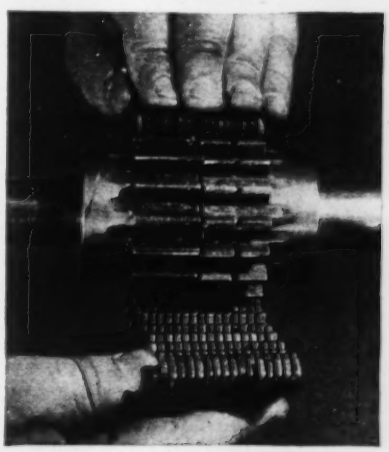


SCARIFIER REGULATED BY HYDRAULIC CYLINDER

tween the scarifier casting and the wheel frame. The weight of the machine, which is of unusually rugged construction, is carried by two 30-in. wheels with 12-in. trends.

Silent Chain Utilized in Flexible Coupler

Rigid connection between two shafts often results in heavy bearing wear because of the difficulty in securing perfect alignment. To eliminate this difficulty the Morse Chain Company, Ithaca, N. Y., has developed a new type of flexible coupling which permits minor variations in alignment and at the same time efficiently transmits power. In construction this coupling is very simple; it consists merely of two pinions, one fastened to each shaft, around which are wrapped a suitable length of Morse silent chain. While not essential, better results are secured by adding a housing to exclude dirt and grit and also to hold in place a felt oil retainer which provides lubrication. The dust cap is available in two forms, one of which revolves with the shaft, the other being stationary. Ease in uncoupling is secured by the construction of the chain which can be detached by simply removing a pin and unwrapping. This pin fastening is very positive and the possibility of accidental disconnection is remote; however, to



ASSEMBLING CHAIN-TYPE COUPLING

provide for contingencies in which positive drive must be secured at all times a special type of coupling is produced in which is incorporated a jaw clutch in the face of the two sprockets. Sizes available for all customary installations will transmit power varying from a fraction of a horsepower up to over 2,000 hp. at speeds as high as 8,000 r.p.m.

Machine Cuts Grooves for Pipe Joints

Certain types of joints and piping require the cutting of a groove around the circumference of the pipe near its end. For cutting this groove the Borden Company, Warren, Ohio, has developed three types of tools for use with pipe varying from ½ to 16 in. in diameter. The smaller of these, model 12, which is both a grooving and a cutting-off tool, is used with pipe from ½ to 2 in. in diameter and is for hand operation only. For larger pipe, varying from 2 to 3½ in. and from 4 to 7 in., there are two models, known as 20 and 50, which

MACHINE FOR GROOVING PIPE

are alike in design but vary in size. As these tools lock on the pipe by means of an internal chuck, the cutting knives work in a perfect circle regardless of the fact that the pipe itself may be out of round, a point of considerable importance, since very few lengths of pipe, particularly in the larger sizes, are perfectly circular. This locking device consists of a threaded bolt which goes through the center of the tool, over which is placed a double-ended cone on either side of which there are four links which are expanded by the cone when the bolt is tightened. The tool itself may be operated by one man or by power, as desired.

Larger pipe sizes, from 8 to 12½ in. and from 14 to 16 in., can be grooved by tools 120 and 160, which have a slightly different type of internal locking device. Because of the weight of these tools, two men are required to place them on the pipe, but once in position, one man can operate the grooving tool. However, because of the greater speed of operation, the company recommends the use of a power drive for the large sizes.

Costs and Contracts

E. N.-R. Index Numbers

Cost		Volume	
Jan. 1, 1930	**208.96**	**December, 1929**	**166**
Dec. 1, 1929	209.46	November, 1929	245
Jan. 1, 1929	209.40	December, 1928	244
Average, 1929	207.02	Average, 1929	317
Average, 1928	206.78	Average, 1928	287
1913.....	100.00	1913.....	100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Jan. 16, with some comparisons, total as follows:

(In Thousands of Dollars)

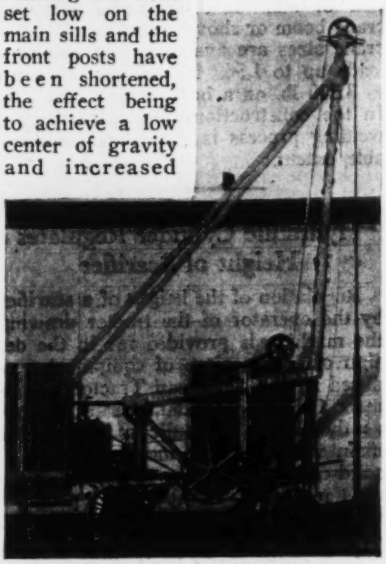
	Jan. 16, 1930	Jan. 9, 1930	Jan. 17, 1929
Buildings:			
Industrial.....	$18,546	$1,794	$53,444
Commercial....	22,038	16,749	37,813
Streets and roads.	7,449	4,516	6,271
Other eng. constr.	9,132	19,256	64,154
Total.....	$57,165	$42,315	$161,682

Total, all classes, Jan. 1 to Jan. 16:

1930.....	$139,497
1929.....	279,555

Steel and Wood Combined in Light Well Drill

Probably the most striking feature of the new model 1½ light traction blast hole drill offered by the Keystone Driller Company, Beaver Falls, Pa., is the fact that the frame is constructed entirely of steel channels and angles, while the walking beam and derrick are of wood, this combination serving to gain the lightness and strength of steel framing while retaining the resiliency and cushioning effect of timber. In the new machine all drilling machinery and shafting has been set low on the main sills and the front posts have been shortened, the effect being to achieve a low center of gravity and increased stability for moving short distances with the derrick erected. The machine is designed primarily for blast hole drilling and is equipped with iron-tired wheels, cutter bands and cleats. It can be furnished with rubber truck tires for movement over paved roads if desired. While designed for use with manila cable, the outfit can also be equipped with a spudding spring and cushion for use with wire line. Power can be supplied either by a four-cylinder 20-hp. Waukesha motor or by an electric motor. The outfit is self-propelled, having three traction speeds forward and one reverse, with a high speed of about 8 miles per hour.



WELL DRILL WITH RUBBER-TIRED WHEELS AND GASOLINE POWER

Ease of Application Features New Facing Metal

One of the greatest objections to the use of hard facing deposits of tungsten carbide for resisting wear on construction equipment has been the amount of preparation and skill necessary in the application of the deposit. With this fact in mind, the research laboratories of the Stoody Company, Whittier, Calif., have developed a new hard facing material known as Borod, which requires neither process nor preparation and may be applied by either the electric welding arc or the oxyacetylene flame by the ordinary welder without special instruction. This material deposits an overlay with characteristics very similar to Borium, a diamond substitute, yet is marketed in the form of a welding rod. The deposit is composed of minute particles of tungsten carbide cemented in place and to the parent metal by fused iron and tungsten-iron alloy. When fractured, the deposit has the granular appearance of a fine grade of tool steel, yet the surface of the deposit and the entire body register a degree of hardness and resistance to abrasive wear which is characteristic of pure tungsten carbide.

New Publications

Air Compressors—CHICAGO PNEUMATIC TOOL COMPANY, New York City, has prepared a second edition of its bulletin 788 describing the improved type P6 vertical single cylinder air compressors, both air- and water-cooled, with piston displacements of 17½, 23 and 41 cu.ft. per minute at 150 lb. per sq.in. maximum pressure. These may also be used as vacuum pumps.

Wiring Equipment—CROUSE-HINDS COMPANY, Syracuse, N. Y., has issued a new 280-p. catalog of its products, including condulets, groundulets, plugs and receptacles for electrical wiring.

Building Design—MORTON C. TUTTLE COMPANY, Boston, Mass., has issued a 4-p. brochure, "The Road to Economy in Building," pointing out the importance of proper design in building development and the value of close co-operation between the builder and the designer in developing plans.

Explosives—E. I. DU PONT DE NEMOURS & COMPANY, Wilmington, Del., in an explosives service bulletin discusses blasting on highway construction projects.

Welding—LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, describes the process of arc-welding pipe lines in a recent illustrated bulletin. The subjects treated include various types of pipe joints, river crossings and inspection and testing. This company has also issued a series of studies in structural welding comprising eight plates, each of which describes the advantages of arc welding in the solution of a structural steel problem.